

My mobile says I'm depressed, now what?

The rise of stress, anxiety, and depression on college campuses, and how mobile can help

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Struggling millennials. For many students the college years are happy and formative. Student life is filled with going to class, studying, partying, taking exams, and dealing with friends, family, and deadlines. From the moment students arrive on campus they learn to negotiate college life without their trusted, familiar support networks. As they move from semester to semester concerns range from friends, relationships, grades, dorm life, time management, social life, drinking, sex, safety, dealing with conflict, money issues, professional development, and simply overcoming everyday difficulties. Getting enough exercise, sufficient sleep, and eating healthily are not priorities. Increased academic pressures, social demands, socio-economic challenges, and cultural differences, as experienced by first generation students and underrepresented minorities, can affect self-worth. Many students overcome such difficulties and excel during the college years, but a growing number of millennials struggle, fail, and drop out of school. Social media is replete with reports of increasing rates of stress, anxiety disorders, depression, and suicide among college students begging the question: why is the most connected, tech savvy generation in our history struggling?

Rising trends in mental health problems. A recent survey of American freshman (New York Times, Feb 5, 2015) found increasing rates of students feeling depressed compared to 5 years ago. Those who felt overwhelmed by schoolwork and other commitments rose to 34.6 percent from 27.1 percent. Another study of Facebook profiles found that 25% of college students displayed depressive symptoms in status updates. A 2014 student survey at Dartmouth College showed that depression and anxiety were the most common health problems, exceeding national averages in the general adult population; 11% of Dartmouth students reported being diagnosed with depression, 12% said that depressive symptoms had negatively impacted their academic performance, and 28% had seen a mental health counselor over the last year. Dartmouth is by no means an outlier. Rather, it is in line with national trends.

The Centers for Disease Control and Prevention recently reported that between 2007 and 2013 the suicide rate among 15 to 24-year-olds increased from 9.6 to 11.1 deaths per 100,000. Active Minds, the leading advocacy group raising awareness of mental health among college students, reported that suicide is the second leading cause of death among college students, claiming the lives of 1,100 students each year. Furthermore, half of students who have suicidal thoughts never seek counseling or treatment. While there is clear evidence of rising trends in mental illness and suicide on our campuses, there is little known about why this upward trend is happening now.

College stakeholders. There are a number of stakeholders associated with student health and wellness on college campuses: the students themselves, friends, families, academic and residential deans, wellness administrators, senior administrators, faculty, coaches, and most importantly physicians and mental health counsellors. All have different viewpoints of students. I would argue that none of the stakeholders have a complete picture of what is truly going on. As a teacher I would posit that most faculty are unaware that their students are struggling beyond grades. As a result the stakeholders remain disconnected.

Because of the stigma associated with mental health on college campuses, many students who are at risk do not reach out to friends, family, deans, or their broader support network. Sometimes students are simply unaware that they are dealing with a mental health problem (e.g., a student who suffers their first depressive episode as a freshman). Even if students are cognizant of their mental health, walking across campus to talk to a physician or mental health counsellor can seem a daunting task. Some students seek out familiar forums to deal with their mental health. One member of the Active Minds group at Dartmouth told me “I don’t like to burden my friends with my problems because they are too busy” when asked if he talked to a close friend when feeling blue. He went on to explain he used the popular geo-fenced, anonymous social network, Yik Yak as a therapeutic outlet when down. He has a sense that there was a community out there. Use of Yik Yak in this manner runs counter to the app’s negative press on bullying incidences.

Mental health sensing. In order to get a sense of what was going on “under the hood” we conducted the StudentLife study at Dartmouth College in the spring 2013. Over a 10-week term 48 students used the StudentLife app on their Android phones. The app used passive sensing and machine learning algorithms on the phones to assess mental health (i.e., stress, depression, loneliness, flourishing), academic performance (i.e., grades, GPA), and behavioral trends (e.g., sociability, sleep, mobility, studying, partying, class attendance). Results from the study indicated strong associations between passive sensor data and established clinical survey outcomes, such as, the PHQ-9 depression scale, perceived stress scale, and UCLA loneliness scale.

Currently, there is no “fitbit for the brain” that predicts psychological state, such as, stress, anxiety and depression. We need one. There has been considerable advances in understanding physical health from the work on activity recognition (now embedded in all iOS and Android devices) to specific physiological sensors integrated into consumer wearables (e.g., Samsung Simband, Apple Watch, Microsoft Band). While researchers have found statistically significant correlations between passive sensing data from phones and clinical depression there is little evidence that we can easily move from correlation to prediction of these states.

A key challenge for college student health is to develop passive sensing technology, learners, and new measures to reliably infer mental state without the need for traditional surveys (e.g., PHQ-9) or ecological momentary assessment (EMA), which do not scale for long term use (e.g., over 4 years at college). A step in that direction is to develop new computation models that can accurately predict PHQ-9 depression scale in the first instance. Once there is evidence we can do this then we could imagine a future where the

discretely administered PHQ-2 or PHQ-9 is replaced with continuous assessment of depression using passive sensing from mobiles. The big question is how do we get there?

Exposing and exploiting hidden behaviors. The StudentLife app exposes a number of hidden behavioral trends in the cohort not known before. What is striking about the example that follows is that it all comes from automatic inferences from passive sensing data from phones without the need for student input (e.g., EMA).

When students come back from spring break they have fewer but longer conversations with other students -- these look like social conversations, catching up after the break as the term gets underway. Students don't sleep much during the first week and the data indicates partying peaks in the first week of term when studying is not a priority. Students are active and exercise during this period. The data shows that the big weekly party days are Wednesday, Friday and Saturday and in preparation for this students study harder Sunday through Wednesday. This study-party interplay remains consistent across the term.

As the term progresses students sleep and exercise less. At the start of the midterm period they start to have more frequent conversations compared to earlier in the term but the duration of these conversations are considerably shorter -- perhaps indicating interaction is now more business than social reflecting the rising stress level associated with midterm exams. Strikingly, students stop going to the gym at the start of the midterm period and do not return to the gym. Class attendance starts to drop off steadily as the term progresses but self studying begins to rise at the end of the midterm period and keeps rising until finals. During the last week of term before finals students are hardly sleeping, but they begin to engage in longer more frequent conversations with each other, they are less mobile, have stopped partying, and are studying harder.

While these findings are perhaps unsurprising the fact that they come from objective sensor data from a mobile is surprising. As we develop better sensing, machine learning, and data analytics we are likely to uncover more interesting behavioral dynamics (e.g., relapse, stress patterns), be able to personalize methods to boost the performance of human sensing and inference systems, and present students with mental health signals that they can gain confidence with.

Build it and they will come? Engagement is a critical factor in getting students to reflect on their mental health signals. Once we can accurately infer mental health, how can we engage students in their own mental health signals? Students live complex lives where health is unfortunately not a top priority. We could develop a mental health app (the name sounds scary). But will students adopt such an app? One school of thought is: build it, they will come. However, this generation are more likely to engage within their own social networking ecosystems. Take the student who did not engage his friends or seek counselling when feeling down but surprisingly turned to Yik Yak. He felt he was reaching out to a community of students, albeit anonymously, on his own time, in his own space.

Future student interventions. The development of a mental health app for students must consider new forms of intervention strategies. This could range from adapting existing techniques, such as, cognitive processing therapy, or inventing new approaches. Another aspect of intervention is putting the control of

sharing signals in the hands of students themselves. For example, consider the stakeholders with their limited view of student life and health. Is there a way to create a more effective support network by allowing students to activate and deactivate nodes in their stakeholder network to share their signals with? This raises a number of tricky privacy issues.

During the StudentLife study I had access to survey outcomes, real-time sensor data streams, and EMAs for all students in the study. In two cases, I intervened and did not give failing grades to students in my Android programming class (and the study) who failed to complete a number of assignments and missed lectures for several weeks. Rather than failing them (which I am obliged to do under normal circumstances), I gave them incomplete grades which allowed them to complete their missed assignments over the summer and pass the course. However, in the other two classes that these students took that term, their professors did not have the StudentLife data available to them and these students received failing grades. While access to such data is under IRB and cannot be shared outside of the direct research group, the data and ad hoc intervention in grading enabled these students to return to campus the following fall. If they had received 3 failing grades that spring term, they would have been automatically suspended for one term. One student contacted me in the summer and was surprised and relieved that he received an incomplete in my class because that allowed him to return for his senior year in the fall. I met both students on their returned to Dartmouth that fall. Neither student brought up their mental health problems with me, nor did I ask.

Scaling StudentLife to more campuses. While StudentLife presents a first effort at mobile sensing specifically design for college students, the study itself has numerous limitations: small N; a single term study; the cohort was mostly computer science students, open questions of bias in the data; the cohort was also made up of high achievers (i.e., the top high school performers) attending a small Ivy in a rural New England town; in addition there was a lack of ethnic and racial diversity, and first generation students in the cohort; finally, only Android users were recruited because iOS does not fully support continuous passive sensing in the background without jailbreaking the phone. While the StudentLife dataset is publicly available (<http://studentlife.cs.dartmouth.edu/>) for other researchers to use there is a need to overcome these limitations and repeat the StudentLife study at a set of diverse colleges across the country to determine if the results found in the Dartmouth study are generalizable or not.

Mobile can help. We need a means to engage the millennials with their own mental health signals and allow them to activate their stakeholder support network, if needed. We need to develop continuous measures of stress, anxiety, and depression. These measures need to be computed passively in the backgrounds of students' phones and wearables -- unobtrusively, with no taxation or burden on users. We have to find new ways to inject this signal into students' ecosystems (e.g., Yik Yak) so they can take notice, and not create yet more new apps that remain unvisited. We need to expose hidden behaviors about student life to students. Signals that are pertinent to their mental health. Challenges include developing new mental health models, engagement strategies, interventions, and stakeholder networks. Critically, we need to find new ways to engage the student population in their mental health. Allow them to reflect on their signals, develop coping skills (e.g., stress management), enact lifestyle changes, and above all stay mentally healthy. For all students the college years should be happy and formative. Mobile can help.