

Identifying Suicidal Behavior Among the General Population (Case Study) Steven Cracknell

At the intersection of Psychology and Technology

Nearly 1 million people die by suicide worldwide each year, according to the World Health Organization. That is about 1 death every 40 seconds. Yet despite public and private investments into research, we continue to lack an effective means by which to predict and prevent suicide.

According to Harvard Psychologist Matthew Nock, approximately two-thirds of people who die by suicide provide some verbal signal to those around them prior to their death that they were considering taking their own life. Additionally, changes in behavior, mood and temperament of individuals over time (i.e. stress, anxiety, anger) can also provide key indicators into a person's changing state of mind. However, these kinds of signs are not specific enough to use to make an intervention since they are not unique to suicide. More direct statements (e.g., "The world would be better off without me," or "I can't take this anymore") are more specific than the symptoms noted above, but such statements are still not specific enough to warrant action. Early detection and intervention is by far the most successful means of prevention for any kind of unwanted outcome, yet the challenge with suicide is to quickly identify and make sense of the available signals in order to take effective action.

With the proliferation of electronic communication mediums (email, instant message, chat, forums), there are many more venues for people to make posts prior to their deaths indicating that they are/were considering suicide. These electronic data sources contain vast amounts of unstructured data which may hold the keys recognition of impending suicide, and thus be a means towards improving prevention. The goal is to find patterns of symptoms and statements that are specific enough to warrant action.

Studies of suicide risk typically rely on retrospective self-reporting, which limits our ability to observe an emerging pattern that has enough diagnostic sensitivity and specificity to identify instances where the person is likely to kill themselves. While we can cull important data and trends from these studies, there is significant need for studies that reveal self-injurious intentions in real time.

Utilizing a state of the art, real-time processing technology and context-based linguistic algorithm--combined with the world's most learned minds on suicidal behavior--could provide the potential and significant means to predict (and prevent) suicide.

Zenti Technology & Methodology

Zenti powerfully combines human contextual pattern recognition with machine intelligence. The result is a tool capable of understanding communication in context, categorizing information in subject matter classes and identifying human emotion and intent. Zenti can do this in real-time, on any volume of data and in any language.

Zenti uses a unique tokenization methodology to weight, score and classify each item of text so as to calculate 'how much' the underlying text relates to a predefined classifier of interest. The scores are measured in decibels and the more the text is about a class, the 'louder' the result. Scores are normalized and range between 0 – 100.

Indication of future behaviors

The Zenti tools allow a real-time review of social media data which reflects the moods, behaviors, and desired public image of an individual. This data allows for score development and testing, meaning an at-a-glance proxy indicator for the current behavioral state of an individual. Such scores can be baselined to both an individual's normal operating mode, and against average population thresholds. Such score development means that subject matter experts will be alerted when there are changes in an individual's profile that warrant review.

Tracking Suicide Risk Factors Through Twitter

In October 2013, Brigham Young University published a groundbreaking piece of research titled: [Tracking Suicide Risk Factors Through Twitter in the US](#). The research showed that suicide is a leading cause of death in the United States and that social media such as Twitter, is an emerging surveillance tool that may assist researchers in tracking suicide risk factors in real time.

Building off of this work, Zenti used its machine learning algorithms to create classifiers that identify patterns, behavioral trends and signals in language that are associated with suicidal tendencies. The Zenti system is able to capitalize on the three critical components necessary to effectively monitor, analyze and act on social media data feeds: **speed, volume and context**. Using the known language patterns of persons at risk and Zenti's ability to move quickly so as tracking items in real time, Zenti sought to produce a proof-of-concept classifier prototype system to detect language used by someone at risk of suicide. Our proof-of-concept classifier is made up of a number of risk factors: depression, bullying, self-harm, being abused, addiction, anxiety and mental disorder.

Below we present one example. Table 1 contains a Twitter profile of a person whose Twitter history scored highly against our classifier, meaning that the text samples were statistically similar to language patterns used by someone at risk of suicide. This person (@depressedgxrl) committed suicide after posting their final tweet on Oct. 3, 2013.

This classifier will identify Tweets that had a positive score (i.e., statistically similar to the language used by someone at risk of suicide), and "red flag" the user. When reviewing the red-flagged Tweets, we can decide to pull the person's full public Twitter history and score that against our classifier. Figure 2 is the public history of @depressedgxrl, scored against our classifier. From this, we can note that any highly scoring Tweet is not an isolated incident, but rather represents, a prolonged pattern of behavior.

Date	Tweet	Score
3-Oct-2013	i see y'all in heaven	13.15
3-Oct-2013	goodbye everyone i loved you all	17.84
3-Oct-2013	sorry it's over	3.87
23-Sep-2013	RT @lamBrokenBitch: I am so good at faking my feelings, my smile, my laugh. Everyone believes it.	39.14
22-Sep-2013	pretty much http://t.co/C78lzMVArW	2.05
22-Sep-2013	RT @killmepls_: It takes a lot of self hate to actually put a knife or blade to your skin and cut yourself.	46.98
22-Sep-2013	no one loved me until http://t.co/PVfzvL0Xo0	5.27
22-Sep-2013	I'm still alive i just have a really hard period and i need to figure some things out	29.52
9-Sep-2013	RT @lamBrokenBitch: Nobody wants me.. http://t.co/aJiP5i4XA2	15.64
9-Sep-2013	save me from myself	8.84
6-Sep-2013	life is so hard	3.61
5-Sep-2013	staying clean is like the hardest thing ever. i don't think i can hold it much longer	27.88
4-Sep-2013	RT @skinnylove40: I was reading this blog about this girl who's 26 and still struggling and idk it just scares me so much that what if i ne...	35.66
4-Sep-2013	RT @x_stopthehate: i'm the ugliest girl in my class.	18.75
4-Sep-2013	my friend has a huge thigh gap http://t.co/XZqjNjwHp4	3.75
1-Sep-2013	i'm scared for people. scared for the fact that they will hurt me	19.07
1-Sep-2013	dying is the only way to don't feel this pain	18.79
31-Aug-2013	This is for you. Yeah, you who is reading this. Listen closely.. you were put in this world for a purpose. (cont) http://t.co/WO1zulg03z	6.97
30-Aug-2013	i told my best friend about how depressed i was and she really helped me. to be honest i don't think i'll ever be that depressed again	45.53
30-Aug-2013	i'm so worried i hope my friend didn't kill herself	25.22
30-Aug-2013	sorry for not being online lately but i was so down. i didn't know what to do with myself	30.08
26-Aug-2013	i just feel idk	3.82
25-Aug-2013	i feel so fucked up	8.84
25-Aug-2013	i fucking lost 1 pound :')	2.28
24-Aug-2013	why i'm excited for school http://t.co/f73m1T085T	7.78
24-Aug-2013	i'm so hungry omfg please help me	15.46
24-Aug-2013	@CutsToScars_ i thought you were 16 or something ☐	4.36
24-Aug-2013	guys give me advice to skip dinner	2.72
24-Aug-2013	RT @CutsToScars_ : okay 10 rts for a selfie . i'll get no rts but it's ok	10.71
24-Aug-2013	i'm so hungry omg but i can't eat	9.01
23-Aug-2013	i'm gonna be so proud of myself, i'm not gonna eat anymore except for dinner :)	29.52
23-Aug-2013	i'm sure that when i'm 20 or something i'm gonna use so many drugs to take the pain away	25.42
23-Aug-2013	i wanna forget about everything	7.86
23-Aug-2013	i'm not afraid to die	9.18
23-Aug-2013	i wanna jump for a train	7.28
23-Aug-2013	i see them coming..	4.87

Table 1. Tweet history of @depressedgxrl that scored highly against Zenti's Suicidal Language Classifier from Aug. 23, 2013 through Oct. 3, 2013.

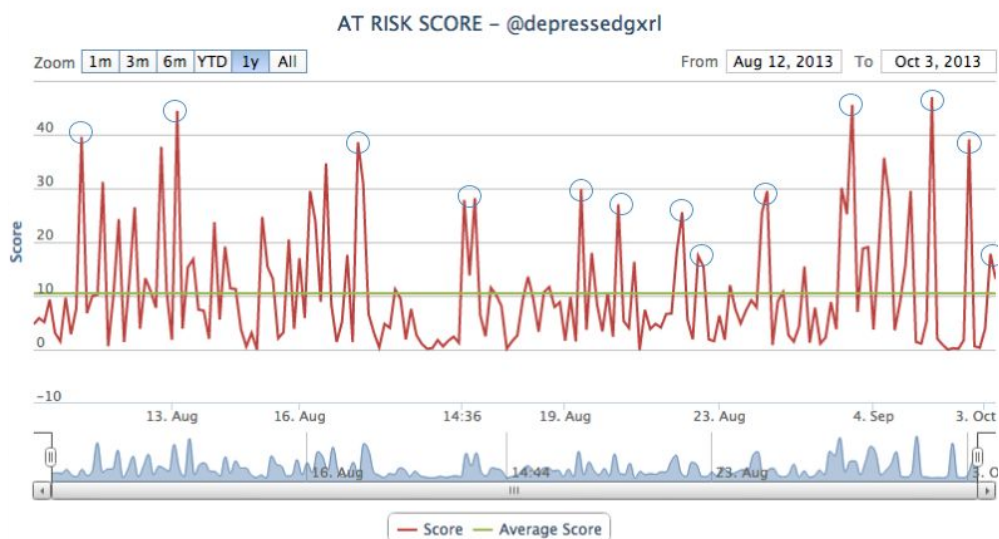


Figure 2. A score profile of @depressedgxrl Twitter history from Aug. 12, 2013 through Oct. 3, 2013. Note that all Tweets are scoring positive against this classifier.

Zenti's preliminary work in detecting at risk individuals proved successful, making a Zenti system of classifiers a key component to enabling core preventative and intervention measures to suicidal behavior. Since this successful proof-of-concept, Zenti has paired with leading researchers in the field of suicide research to develop meaningful programs that are the next step once an at-risk individual has been identified.

Suicide Prevention Initiatives Using Twitter

Devastatingly, this specific profile of @depressedgxrl was identified in September 2014 while the system was still being developed and tested, but before this person had committed suicide. This realization spurred the Zenti team to reach out to leading experts in suicide research as partners in intervention strategies. We worked with leading experts at Harvard, Yale, and Brigham Young University to establish research design plans for validating the Zenti system.

Most recently, Zenti has worked with Dr. Joe Franklin (Florida State University, previously Vanderbilt University) on projects to develop tools for identification of suicide decedents and prediction of future suicidal behaviors. By using Twitter as the social media source, Dr. Franklin's team has the opportunity to immediately and directly intervene with individuals. His work in suicide prevention can be found on [his website](#).

Zenti also has completed early stage work with other institutions on "Red Flag Behaviors," which includes identification and verification across an array of indicators, and monitoring of such open source social media accounts.

An Open Invitation for Collaboration

Zenti is actively looking for collaborators and funding groups who can use this real-time technology to develop and implement intervention programs. As a partner, we can aid in providing the technical tools and know how, but we are not trained psychologists or counselors--we need experts to use these powerful tools for the greater good.

Please don't hesitate to reach out.

www.zenti.com