Predictive Analytics for Mental Health Outcomes: A Case for Novel Applications of the Hedonometer*

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*Hedonometer developed in collaboration between University of Vermont and MITRE (Matt McMahon and Brian Tivnan)
Discussion Overview

▪ Introduction:
  – The *Hedonometer* is an instrument to remotely-sense emotional states and levels, in real time or post hoc.
  – *The Hedonometer* provides an analytical platform to perform large-scale, sentiment analysis on many corpora in 10 global languages.

▪ Development:
  – The *Hedonometer* arose from a longstanding collaboration between the Computational StoryLab at the University of Vermont (UVM) and The MITRE Corporation.

▪ Advancement:
  – The team has explored various applications of the Hedonometer as an initial screening tool for detecting mental health outcomes in advance of clinical diagnoses.

▪ Today:
  – Our collaborative pursuit: applying the *Hedonometer* as an initial screening tool to identify those Veterans at greatest risk to attempt suicide.
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We believe in the power of partnership and trusted engagement to solve our nation’s toughest health problems, for a safer world.
MITRE Partners with Academia to Discover Novel Way to Measure Public Sentiment

- MITRE invests in partnership with University of Vermont (UVM)

- Resulting in the development of the Hedonometer
  - Analytical tool to perform large-scale sentiment analysis of social media content

- Extensions of Hedonometer to improve health outcomes for veterans
  - Early warning of emerging mental health issues like depression and PTSD
  - “Veteran-ometer” Application of Hedonometer specifically tuned for “veterans”
Average Happiness for Twitter

- Christmas Day
- Mother's Day
- Wedding of Prince William and Kate Middleton
- New Year's Eve
- Valentine's Day
- Independence Day United States
- Same-sex marriage declared legal in the U.S.
- Pandemic: H1N1 Influenza Virus
- Earthquake in Chile
- Tsunami in Japan
- Death of Osama bin Laden
- Earthquake and Tsunami hit Sumatra Indonesia
- Death of Robin Williams
- Bombing at Boston Marathon
- Not Guilty Verdict for George Zimmerman
- Terrorist attacks in Paris
- Terrorist attack in Orlando
- Election of Donald Trump as U.S. President
- Mass shooting in Las Vegas
Scientific Rigor of Hedonometer

- Hedonometer has been extensively vetted

- Additional Applications
  - “Pattern of Life”
  - “Geography of Happiness”
  - “Lexicocalorimeter”
References: Scientific Foundation of Hedonometer

- Several examples of peer-reviewed publications in top-tier, scientific journals

- Extension of Hedonometer beyond English to 10 global languages
  - *Proceedings of the National Academy of Sciences*, “‘Human language reveals a universal positivity bias.’” [Link to Publication](#)
  - This paper won MITRE’s 2015 Best Paper competition. [Link to MITRE Announcement](#)
  - Recognized as #100 of Top Scientific Studies to “Capture the Public Imagination in 2015.” More here: [https://www.altmetric.com/top100/2015/](https://www.altmetric.com/top100/2015/)

- Computational approach for efficient and scalable screening for depression via Instagram
  - *EPJ Data Science*, “Instagram photos reveal predictive markers of depression.” [Link to publication](#)
  - Recognized as #17 of Top Scientific Studies to “Capture the Public Imagination in 2017.” More here: [https://www.altmetric.com/top100/2017/#list&article=10422853](https://www.altmetric.com/top100/2017/#list&article=10422853)

- Extension of efficient and scalable screening for depression and PTSD via Twitter
  - *Nature’s Scientific Reports*, “Forecasting the onset and course of mental illness with Twitter data” [Link to publication](#)

- Confirmed by controlled experiments, Hedonometer is without peer
  - *EPJ Data Science*, “Sentiment analysis methods for understanding large-scale texts.” [Link to Publication](#)

- Many more here: [http://hedonometer.org/papers.html](http://hedonometer.org/papers.html)
Predicting Depression from Instagram

Instagram photos reveal predictive markers of depression

Andrew G Reece and Christopher M Danforth

EPJ Data Science 2017 6:15 | https://doi.org/10.1140/epjds/s13688-017-0110-z | © The Author(s) 2017
Received: 28 March 2017 | Accepted: 22 June 2017 | Published: 8 August 2017
Predicting Depression and PTSD from Twitter

Forecasting the onset and course of mental illness with Twitter data

Andrew G. Reece, Andrew J. Reagan, Katharina L. M. Lix, Peter Sheridan Dodds, Christopher M. Danforth & Ellen J. Langer

Tracking Depression onset with state-space modeling

Tracking PTSD onset with state-space modeling

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Pilot Study at University of Vermont (UVM): Predictors of Suicide Risk

- Using social media to identify predictors of suicide risk
- Extending from two previous studies (Instagram and Twitter)
- Leveraging unique dataset from UVM hospital
  - 1500 individuals who have died by suicide in VT, NH and northern NY
  - Names, cities, activity matched w/100 billion tweets in last decade
“Veteran – ometer”

- Application of Hedonometer specifically tuned for “veterans”
  - Nearly ten years of Twitter data
  - Sentiment analysis for tweets containing “veteran”
  - Relative count of tweets in the veteran set that contain “opioids”
“Veteran – ometer”

- **Zoom in to 2016-2018:**
- **Dates Highlighted**

Notes: We are working to add dates, events, VA press releases, and analysis around all the “outlier” dates—extreme lows and highs in the data.
"Veteran – ometer:” Explaining differences with Word Shifts.

Nov. 14, 2017 (Veterans Day)
Average Happiness: 6.40
What’s making this day happier than the previous seven days:

May 29, 2017 (Memorial Day)
Average Happiness: 6.05
What’s making this day happier than the previous seven days:

October 9, 2017
Average Happiness: 5.14
What’s making this day sadder than the previous seven days:
Potential Applications at VA

- Assessing and understanding veteran sentiment
- Leverage well established MITRE & UVM team of Data Scientists, Computational Social Scientists, and Psychiatrists
- Quantifying and comparing analytics
  - Rigorous emphasis on quantifiable sentiment, insight into longitudinal changes over time
  - Insight into the relevance of metadata relating location, TOD, relationships with other datasets, etc.
- *Proof of concept studies increasingly suggest there are linguistic & other behavioral predictors of state of mental health state, including suicidal.*
- *Complete pilot study initiated at UVM Medical Center and potentially extend to VA, given a training set of VA data*
  - veterans w/wo mental health diagnosis who have died by suicide
  - veterans w/wo mental health diagnosis who have not attempted suicide
- *Build algorithm to identify predictors in classification task, validate on separate set of data.*
Thank you!

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Follow up

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