Towards a Micro-Blog Platform for Sensing and Easing Adolescent Psychological Pressures

Yuanyuan Xue
Tsinghua National Laboratory for Information Science and Technology Key Laboratory of Pervasive Computing, Tsinghua University, China
xue-yy12@mails.tsinghua.edu.cn

Qi Li
Tsinghua National Laboratory for Information Science and Technology Key Laboratory of Pervasive Computing, Tsinghua University, China
liqi0422@gmail.com

Ling Feng
Tsinghua National Laboratory for Information Science and Technology Key Laboratory of Pervasive Computing, Tsinghua University, China
fengling@tsinghua.edu.cn

Gari D. Clifford
Institute of Biomedical Engineering
University of Oxford, U.K.
gari.clifford@eng.ox.ac.uk

David A. Clifton
Institute of Biomedical Engineering
University of Oxford, U.K.
davidc@robots.ox.ac.uk

Abstract
Adolescent mental health cannot be ignored, and psychological pressure is one of the prominent problems of current teenagers. Micro-blog, as the most important information exchange and broadcast tool in the current society, is becoming an important channel for teenagers' information acquisition, inter-interaction, self-expression, emotion release due to its unique equality, freedom, fragmentation, individuality characteristics. This poster envisions a micro-blog platform, aiming to (1) sense psychological pressures through teenagers' tweets, and (2) assist teenagers to release their stress through micro-blog. A method for timely detecting psychological pressures from teenagers' tweets is particularly described. Our preliminary experimental results on real data demonstrate the validity of the approach. We also discuss ways to assist teenagers to release their pressures through micro-blog at the end of the poster.

Author Keywords
Teenager, psychological pressure, micro-blog, sense, ease

ACM Classification Keywords
H.2.8 [Database Management]: Database Applications.

General Terms
Algorithms, Experimentation

Introduction

Growing teenagers experience adolescent psychological pressures coming from study, communication, affection, self-recognition, etc. Statistics from [2] show that over 17% of 1000 college students feel the stress, leading to suicidal thoughts. About one in ten college students who are under the pressure of job searching stated they really want to die in Japan. Currently, annual increase of suicide rate has become a world-wide common problem. The traditional psychological guidance cannot meet the demand of relieving teenagers' stress for its lack of timeliness and diversity.

With micro-blog becoming the most popular information broadcast and communication media, more and more teenagers go to micro-blog for information acquisition, self-expression, and personal interaction. According to Chinese Academy of Social Sciences [1], self-expression is still the main usage of tweets (covering 74.3%), compared to other usage like daily life and experience description, information sharing, etc. This makes the detection of teenagers' pressures through their tweets feasible. On the other hand, micro-blog constitutes another media-rich and lively communication channel, through which prompt attention and care can reach pressurized teenagers. It could also act as a virtual friend to $talk$ with the teenagers who sometimes hesitate to express themselves to their parents/teachers.

Adolescent psychological problems arouse multi-disciplinary research for its particular importance. This poster presents a micro-blog platform solution for sensing and easing adolescent psychological pressures (Figure 1). It is comprised of two components. 1) The first *pressure sensing component* analyzes and detects from a teenager's tweets whether s/he has some stress,

and the stress category and level. Four common typical teenagers' pressure categories (i.e., *interpersonal stress, self-cognition stress, affection stress*, and *academic stress*) are considered in this study. 2) Based on the sensed stress category and level, the second *pressuring easing component* encouragingly recommends relevant materials, chats like a virtual friend, or brings guardians' attention at the worst case to assist stressful teenagers.
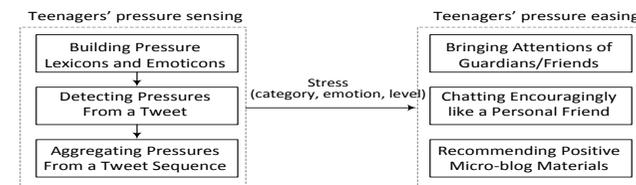

Figure 1: The micro-blog platform.

To our knowledge, sensing and helping release adolescent psychological pressures through micro-blog, and turning micro-blog into a new kind of adolescent mental education mode are a new exploration in the world. It will lead to a number of teenager-oriented micro-blog research and utilization questions as well as possible solutions. We believe that combing traditional adolescent mental education with micro-blog will benefit our human society.

Related Work

There are two directions on the research of sentimental analysis on micro-blog. First is topic-irrelevant sentimental analysis, which focuses on analyzing the sentiment polarity containing positive polarity and negative polarity. Second is topic-relevant sentimental analysis. It focuses on analyzing the sentiment classification like joy, fear, sadness, surprise, anger, disgust. by making large use of traditional text sentiment analysis methods developed in the natural language processing and machine learning

fields, as well as emoticons and labels [4, 5]. Both directions are used mainly for business applications to detect users' opinions towards a product or proposal rather than analyzing the psychological pressures that deeply cause the emotional changes of teenagers.

Sensing psychological pressures through teenagers' tweets on micro-blog

Detecting pressures from a teenager's tweet
We construct four teenager-centered micro-blog lexicons: 1) *stress-category lexicon* contains words about academic, interpersonal, affection, or self-cognition stress, 2) *negative-emotion lexicon* contains such words like hate, dislike, etc, 3) *degree lexicon* contains words like very, especially, etc, and 4) *negation lexicon* contains words like not, seldom, etc. A graph-based Chinese parser [3] is then applied to find out associated word pairs in each sentence of the tweet and generate a word-association graph. Each node in the graph denotes a word, and each edge between two nodes denotes a word association. In Chinese grammar, there are totally 24 kinds of word association like subject-predicate, attributive, adverbial, etc. If there exists a path between a stress-related word node and a negative emotion word node and no negation lexicon word in between, a stress is detected. The path length is the number of edges in the path, showing the linguistic tightness between the two words. The *association distance* is the path length (edge number of the path). The sensing result from a tweet's sentence is thus either null (meaning no stress detected) or a triple $Sense(t_{sentence}) = (C_{ategory}, L_{evel}, C_{onfidence})$, where $C_{ategory}$ is the detected stress category ("academic", "interpersonal", "affection", "self-cognition"), L_{evel} is the stress level, and $C_{ondidence}$ is the detection confidence.

L_{eveli} takes into account the number of degree lexicon words $|D|$ in the same path, as well as the number of negative emoticons $|En|$ and number of exclamation/question marks

$|M|$ in the whole tweet. Let $W_1(degree_d) \in [1, 5]$, $W_2(emoticon_e) \in [1, 3]$, and $W_3(mark_m) \in [1, 2]$ be the weights of the degree word $degree_d$, $emoticon_e$, and exclamation/question $mark_m$, respectively. We assign weight 1 to the question mark, weight 2 to the exclamation mark. The degree lexicon assigns 5 different weights to different degree words. Also, 3 different weights are respectively assigned to positive and negative emoticons. $L_{evel} = (\sum_{d=1}^{|D|} W_1(degree_d) + \sum_{e=1}^{|En|} W_2(emoticon_e)) \times \sum_{m=1}^{M} W_3(mark_m)$.

$C_{onfidencei}$ takes into account the path length between the stress word and negative emotion word in the path, as well as tweet's total number of positive emoticons $|Ep|$, $C_{onfidence} = \frac{1}{(1+|Ep|)^2 + \sqrt[3]{pathLength+1}} \in [0, 1]$. We use cube root here to balance the contributions of emoticons and path length between the two linguistic words.

From a tweet containing multiple sentences, a few stress could be detected $SENSE(Tweet) = (C_{ategory1}, L_{evel1}, C_{onfidence1}), \cdots, (C_{ategoryk}, L_{evelk}, C_{onfidencek})\rangle$, ranked in the order of confidence.

Aggregating pressures from a teenager's tweets sequence
Aggregating sensed stress from a sequence of tweets posted by one or a few teenagers is helpful in predicting implicit stress tendency, dealing with stress overlooked by individual tweet's detection method, and getting an overview of stress fluctuation over a period of time. One challenge here is that most teenagers write tweets using an informal language, and some stress category related and/or degree words may be missing from a tweet. Detecting pressures from a tweet sequence needs to cope with such incomplete elements. Considering that a teenager's stress may last for a while (say, during an exam period), we take neighbor tweets' stress category as the implicit one. Also, stress from neighbor tweets affects the current tweet due to the continuity of emotions. We fill in the missing stress levels based on the previous tweets' stress levels, and the closest tweet has the highest influence. Given a tweet sequence $\langle t_1, t_2, \cdots, t_n \rangle$, without loss of generality, different
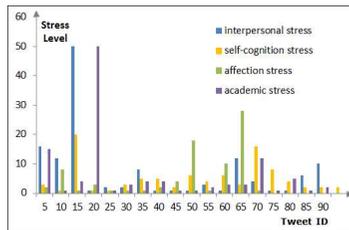
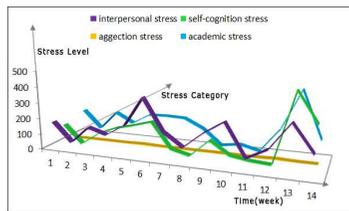**Figure 2:** Stress levels detected from one teenager's different tweets.

Figure 3: Teenager's stress levels aggregated on a weekly basis.

aggregation operations (like Avg, Sum, Count, Max, Min) can enforced. For instance, let $\langle(c, L_{evel1}, C_{onfidence1}), \cdots,$ $(c, L_{evelx}, C_{onfidencex})\rangle$ be a sequence of sensed stress in category c from one week's tweets. We can have $Sum(c, \langle(c, L_{evel1}, C_{onfidence1}), \cdots, (c, L_{evelx}, C_{onfidencex})\rangle) = (c, \sum_{i=1}^{x} L_{eveli}, \sum_{i=1}^{x} C_{onfidencei})$.

Evaluation

Tweets from 10 middle-school students (of age 14-20) are collected from Chinese Sina micro-blog (http://blog.sina.com) from 2012/11/11 to 2013/4/25. Each teenager posted around 500-1000 tweets. We randomly extract 70 tweets from each teenager's tweet sequence. and compare the stress detection result with the one given by our human being. Figure 2 shows the stress levels detected from one teenager's different tweets, with the weekly-based stress level summation in Figure 3. Figure 4 shows the average detection performance, measured in precision and recall, of our individual tweet based stress detection approach.

Teen-ager	Interpersonal		Self-Cognition		Affection		Academic		4-Stress	
	Pre.	Rec.	Pre.	Rec.	Pre.	Rec.	Pre.	Rec.	Pre.	Rec.
1	55.0%	57.9%	41.7%	71.4%	100%	100%	94.7%	51.4%	82.4%	35.0%
2	68.8%	91.7%	17.9%	50.0%	100%	50.0%	81.0%	70.8%	81.8%	31.0%
3	77.8%	80.8%	66.7%	100%	100%	100%	80.0%	69.0%	91.2%	96.9%
4	69.0%	95.2%	38.9%	100%	0.0%	100%	33.3%	66.7%	77.8%	82.4%
5	71.4%	78.9%	33.3%	66.7%	0.0%	0.0%	90.0%	62.1%	73.5%	100%
6	65.4%	85.0%	50.0%	75.0%	100%	100%	66.7%	85.7%	75.9%	78.6%
7	64.0%	94.1%	53.3%	80.0%	25.0%	100%	75.0%	93.8%	77.8%	87.5%
8	63.0%	94.4%	64.3%	100%	100%	47.8%	66.7%	100%	88.2%	55.6%
9	77.8%	95.5%	83.3%	100%	72.7%	61.5%	92.3%	100%	70.0%	77.8%
10	44.4%	88.9%	85.0%	70.8%	92.9%	59.1%	94.4%	77.3%	95.7%	62.9%
AVG	65.7%	86.2%	53.5%	81.4%	69.1%	71.8%	77.4%	77.6%	81.4%	70.8%

Figure 4: The average stress detection performance

Assisting teenagers to release psychological pressures through micro-blog

Teenagers many times hesitate to express their feelings to parents and teachers. Micro-blog, as another kind of social communication mode, could play positive roles. 1) When a teenager is detected to have a strong consistent stress, the micro-blog platform needs to bring the attentions of guardians/friends to care for his/her psychological change and issue helps immediately to avoid tragedy. 2) For a teenager experiencing a moderate stress, the micro-blog platform can chat and encourage him/her like a personal virtual friend. For a teenager experiencing a weak stress, the micro-blog platform can search and recommend relevant encouraging messages or micro-bloggers of positive attitudes to him/her.

Conclusion

We present a framework for sensing and analyzing psychological pressures through teenagers' tweets on micro-blog. Our preliminary experimental results verify our sensing approach. The techniques developed could be extended to tweets in other languages. We are currently implementing the micro-blog based strategies for assisting teenagers to relieve the stress. Integrating multiple sensor sources in stress detection is also interesting to explore.

Acknowledgement

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