

# Helping Teenagers Relieve Psychological Pressures: A Micro-blog Based System

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## ABSTRACT

The rapid development of economy and society brings unprecedentedly intensive competition and adolescent psychological pressures to current teenagers. If these psychological pressures could not be resolved properly, they will turn to mental problems, which will finally lead to serious consequences, such as suicide or aggressive behaviors. Traditional face-to-face psychological diagnosis and treatment cannot meet the demand of relieving teenagers' stress completely due to its lack of timeliness and diversity. With micro-blog becoming a popular media channel for teenagers' information acquisition, interaction, self-expression and emotion release, we present a system called *tHelper* for sensing and easing teenagers' psychological pressures in *study*, *communication*, *affection*, or *self-recognition* through micro-blog. The system adopts Gaussian Process to classify a teenager's pressure (i.e., pressure category, as well as pressure level) based on a number of features extracted from his/her tweets. Then the system provides various methods to help pressurized teenagers relieve their stress according to the sensing results, by sending positive stories, proverbs, pictures, or cheerful jokes, suggesting simple breathing and muscle relaxation exercises, guiding the teenagers to write down something for self expression, and at the worst case notifying their guardians (who have registered the system beforehand) via mobile phone messages. *tHelper* demonstrates how micro-blog can be turned into a new kind of adolescent mental education mode to complement and enhance the traditional face-to-face treatment by psychological doctors.

## Categories and Subject Descriptors

H.2.8 [Database Management]: Database Applications

## General Terms

Design, Algorithms, Experiments

## Keywords

Micro-blog, teenager, psychological pressure, detect, relieve

## 1. INTRODUCTION

Growing teenagers have to experience various psychological pressures, coming from study, communication, affection, and self-recognition. Facing the radical reform of society and economy, they usually more easily get confused and become stressed due to their inherently immature development of self-cognition and discrimination ability towards things. Too much stress will lead to psychological health problems. When these mental issues are too serious and do not get resolved properly, pressurized adolescents will turn to hurt either themselves or others for stress release. Statistics from [2] show that about 20% teenagers in the world are suffering from psychological illness, with 10%-30% in China and 14%-20% in America. In Japan, about one in ten college students who are under the pressure of job searching stated that they really wanted to disappear and die [3]. In Korea, suicide has become teenagers' no.1 killer in the past two years [4]. Nowadays, annual increase of adolescent suicide rate has become a world-wide serious problem.

In contrast to the fact that many teenagers hesitate to tell their parents and teachers about their bad feelings, they tend to go to micro-blog for self-expression, emotion release, and personal interaction. According to Chinese Academy of Social Sciences [1], teenagers aged from 10 to 29 accounts for 55.78% of all micro-blog users, and self-expression is still the main usage of tweets (covering 74.3%), compared to other usage like daily life and experience description, information and comments sharing, etc. For pessimistic adolescents, if we could identify psychological pressures from their micro-blog tweets in a timely fashion, and guide them to think in a optimistic way, we may hopefully save lives. Now micro-blog offers the potential to act as a virtual friend to *encourage* and *interact* with pressured teenagers and help them relieve stress in various ways like sending positive proverbs, stories, cheerful pictures, or jokes, suggesting some simple breathing and muscle relaxation exercises, guiding to write something down, and at the worst case notifying the guardians.

In the literature, most researches in micro-blog based sentiment analysis were for business purposes by extracting people's opinions towards some subjects or products [5]. Usually, people's opinions are classified into two polarities: positive and negative, and sometimes including neutral, while people's emotions are classified into six categories, i.e., joy, fear, sadness, surprise, anger, and disgust. Till recently, using twitter as a tool for public mental health detection, especially depression detection, arouses gradually interests by scholars [7, 6, 11]. While most of the previous work put emphases on depression detection, little researched effective

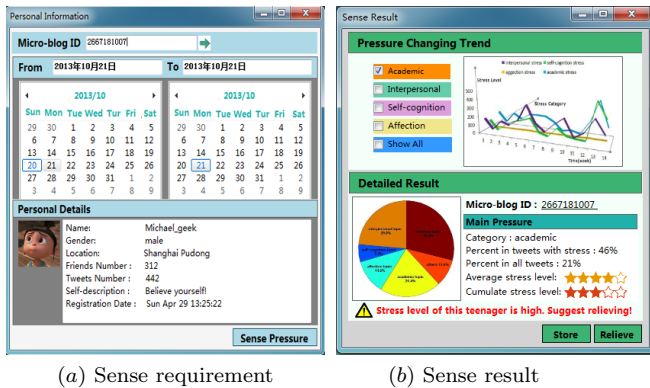


Figure 1: Sensing teenager’s pressures based on micro-blog ID

intervention ways to help these people out of bad moods. In [12], we envisioned a preliminary micro-blog platform for sensing and helping relieve teenagers’ psychological pressures. This paper improves its both detection and intervention approaches, considering a richer set of tweets and user related features and more emotion regulation approaches, given by the psychologists. We further implement the platform and test its usage through a user study in this paper.

## 2. SENSING STRESS FROM TEENAGER’S TWEETS

The system called *tHelper* builds upon two major components (1-sensing teenager’s pressures and 2-relieving teenager’s pressures) based on the teenager’s micro-blog ID. Fig. 1(a) shows the micro-blog ID of the teenager whose pressure is to be sensed, as well as the sensing time period. Detailed information of the teenager, including his/her name, gender, location, number of friends, number of posted and re-tweeted tweets, and signature, are given below. These information can help analyzing the background of the teenage.

*tHelper* considers four adolescent psychologic pressure categories,  $Category = \{\text{NULL}, \text{academic}, \text{interpersonal}, \text{affection}, \text{self-cognition}\}$ , where NULL denotes an unknown category. Let  $Level = \{\text{none}, \text{very light}, \text{light}, \text{moderate}, \text{strong}, \text{very strong}\}$  be the set of pressure levels, where none means no pressure. Given a teenager’s tweet *tweet*, the pressure detection result from *tweet* is either null (meaning no pressure detected) or a few tuples  $PressureDetect(tweet) = \langle (C_1, L_1), \dots, (C_n, L_n) \rangle$ , where  $C_i \in Category$  and  $L_i \in Level$  ( $1 \leq i \leq n$ ) correspond to the detected pressure category and pressure level.

### 2.1 Tweet’s Seven Features

Seven tweet-related features are extracted and analyzed for pressure sensing.

1) *Linguistic Association between Pressure Category and Negative Emotion Words*. For each sentence in a tweet, *tHelper* applies a graph-based Chinese parser [10] to find out associated word pairs, based on the four teenagers’ stress-related linguistic lexicons on micro-blog (i.e., stress-category lexicon, negative emotion lexicon, degree lexicon, and negation lexicon). The discovered associated word pairs form a directed word association tree, where each node denotes a word token, and each edge between two nodes denotes a word as-

sociation. If a path exists between a stress-category-related word node and a negative emotion word node and no negation lexicon word in between, a stress in the corresponding category is detected. The path length is the number of edges in the path, showing the linguistic tightness between the two words. For example, if the path length between “sad” and “very” is short, the tightness is high, presenting a strongly sad emotion.

2) *Number of Negative Emotion Words*. More negative emotion words in a tweet directly present higher possibility and higher degree of negative emotion. *tHelper* considers this data as an indispensable feature to judge if the tweet is with negative emotion.

3) *Number of Positive and Negative Emoticon*. Emoticons are popular among teenagers on micro-blog. Choosing emoticon as a feature avoids grammatical ambiguity, making up the weakness of natural language analysis.

4) *Number of Exclamation and Question Marks*. Exclamation marks are used to indicate extreme emotions such as angry, whiny, etc., and question marks are used to imply confused emotion. This feature presents the intensity of emotions in tweets, either positive or negative.

5) *Emotional Degree*. Emotional degree denotes the intensity of emotion in a tweet. *tHelper* considers 5 elements including negative-emotion word, adverb of degree, negative emoticon, exclamation mark and question mark. Each element is given different weight and contributes to the emotional degree corporately.

6) *Genre of Shared Music*. Sad music conveys sorrow emotion and many teenagers who sink into stress are attracted to share it through micro-blog to express their low moods.

7) *(Un)usual Post Time and Frequency*. Teenagers usually post tweets at relatively fixed time according to personal habits. If a teenager issues tweets at abnormal post time with a different frequency, special emotion is possibly expressed. *tHelper* excludes the abnormal post time on weekends and holidays, considering teenagers may relax themselves and the timetable is different during those periods.

### 2.2 Pressure Detection from Single Tweet

Based on eight features, *tHelper* performs single-tweet based pressure detection. The task is to classify pressure level in  $CSet = \{C_1, \dots, C_6\}$  (corresponding to none, very light, light, moderate, strong, very strong pressure level). The pressure category is identified by examining the tweet words against the stress-category lexicon. Here, the Gaussian Process (GP) framework offers a principled means of performing inference over noisy data [8]. Of fundamental importance is the notion of GP as a distribution over functions, which is suitable to analyze tweets on micro-blog. Through GP, we perform inference over functions.

Given a tweet set  $TSet$ , we define a GP prior distribution over latent (unobserved) functions  $\mathbf{f} = \{f(t) \mid t \in TSet\}$ , according to  $f(t) \sim \mathcal{GP}(\mu(t), k(t, t'))$ , where  $t, t' \in TSet$ ,  $\mu(t)$  is the mean function, and  $k(t, t')$  is the squared-exponential covariance function:  $k(t, t') = \delta_s^2 \exp(-\frac{\|t-t'\|^2}{2\delta_t^2})$ , where  $\|\cdot\|$  is the  $\ell_2$ -norm,  $\delta_t$  and  $\delta_s$  are hyper parameters giving the length-scale in the  $t$ -direction and the variance of  $s$ . Considering additive Gaussian noise  $\varepsilon \sim \mathcal{N}(0, \delta_\varepsilon^2)$  over the latent function, we can obtain the object function  $C = f(t) + \varepsilon$ , where  $C \in CSet$  are the classified categories. Further, the prior GP distribution of  $C$  can be defined for some observed

data:  $C_o \sim \mathcal{N}(0, K(TSet, TSet) + \varepsilon_n^2 I_n)$ , where  $C_o$  is the observed prior category set,  $K(TSet, TSet) = K_w = (k_{ij})$  is a  $w$ -order symmetric covariance matrix, and  $k_{ij}$  measures the correlation between  $t_i$  and  $t_j$  ( $t_i, t_j \in TSet$ ). Through prior GP distribution, we can define joint prior distribution between observed and predicted category set  $C_o, C^*$ . The posterior distribution of  $C^*$  can be formalized as follows:  $f_* | TSet, C_o, C^* \sim \mathcal{N}(\bar{f}_*, \text{cov}(f_*))$ , where  $\bar{f}_*$  and  $\text{cov}(f_*)$  are the mean value and variance of the classification results. Expectation propagation algorithm proposed by [9] is used to approximate inference in GP classification and get the best results of accuracy and speed based on the latent function.

### 2.3 Aggregating Single Tweet Based Detection Results

Aggregating sensed stress from a sequence of tweets posted by one or multiple teenagers is helpful in predicting implicit stress tendency, dealing with stress overlooked by individual tweets 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. 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  $\langle t_1, t_2, \dots, t_n \rangle$ , without loss of generality, different aggregation operations (like Avg, Sum, Count, Max, Min) can be enforced. For instance, let  $\langle (C, L_1), \dots, (C, L_x) \rangle$  be a sequence of sensed stress in category  $C$  from a teenager's 1-week tweets. We can have  $Avg(C, \langle (C, L_1), \dots, (C, L_x) \rangle) = (C, \sum_{i=1}^x L_i / x)$ .

Fig. 1(b) shows sensing results with detailed statistics and visual graphs. The pie chart shows the percentage of each stress category during the sensing period, and broken line graph shows the whole tendency for stress of each category. Primary stress during the choosing period is given in this window, showing the average stress level, accumulated stress level and the percentage of tweets in this stress category. *tHelper* will store these analysis results into a database for later teenager's assistance and analysis purposes.

## 3. ASSISTING TEENAGERS TO RELIEVE PRESSURES

According to the sensed teenager's pressure category and degree, *tHelper* offers three ways (Fig. 2(a)) to help the stressful teenager regulate the emotion and relieve the pressure according to the psychological study.

### 3.1 Assistance 1 (Read Something)

*tHelper* encourages the pressurized teenager by sending some positive material to his/her micro-blog using the symbol "@" followed by the teenager's user name. Such kind of materials can be a proverb, story, cheerful cartoon picture, video, or joke (Fig. 2(b)) illustrates. *tHelper* maintains a large repository containing categorized proverbs and stories corresponding to different stress categories, as well as cartoon pictures, videos, or jokes applicable to all stress categories. These materials are randomly selected and posted to

encourage and cheer up the stressful teenager, who experiences a light, moderate, or heavy stress.

### 3.2 Assistance 2 (Do Something)

*tHelper* guides the pressurized teenager to do some breathing and muscle relaxation exercises (Fig. 2(c)), or write something down to express his/her bad emotions by replying under the tweet posted by *tHelper* (Fig. 2(d)). The system will record what the teenager replies and compose them into a virtual diary. In psychology, it has been proved that anxious mind cannot exist in the body of relaxation. Breathing and muscle relaxing exercises allow oneself to put worry aside and let feeling calm down. When one is in a relaxed state, breathing is often deep and full in the abdomen rather than the chest. Abdominal breathing provides more oxygen and discharges the body of toxins more effectively, so it makes one more relaxed and focused. Like Assistance 1, Assistance 2 interacts with the teenager by the '@+user name' message and the reply on his/her micro-blog. Compared to Assistance 1, Assistance 2 lets the stressful teenager take more active actions for pressure release. It applies to the teenager who experiences a moderate or heavy stress.

### 3.3 Assistance 3 (Notify Guardians)

When the teenager undergoes a consistently heavy stress, *tHelper* notifies his/her guardians (who have registered the system beforehand) via mobile phone messages, so that timely care and external help can reach the teenager to avoid possible tragedy. Such a message includes an objective description of the teenager's psychological states according to the detected result, including stress category, stress degree, and lasting period. Assistance 3 applies to teenagers who have consistently heavy stress.

At the moment, *tHelper* offers the above assistance to the pressurized teenagers once per day, trying to avoid duplicated assistance.

## 4. USER STUDY

After getting fifteen teenagers' (aged 20 - 28) approval, we followed the tracks of their postings on micro-blog for two weeks to test the effectiveness and benefit of the system. During two weeks' tracking, nine participants were detected under psychological pressures and helped by system. The testing results showed that six participants suffered academic pressures and two participants suffered affection pressures, fluctuating between low level and middle level. In terms of the pressure categories and pressure levels detected, some helpful information from our system was sent to participants on micro-blog to ease their moods. To get the user satisfaction with the system, we launched an online questionnaire and asked the participants to pick out the decompressing ways they preferred from the options in questionnaire. The feedback revealed that 44% of participants selected 'read something' when suffering slight psychological pressures, and 78% of participants found 'do something' can make them feel decompressed when under a middle level pressure, as well as 44% of participants preferred 'notice guardian' when they were agonized with severe pressures. They also were asked to rate both the system effectiveness and their satisfaction with the system on a scale of 1 (very poor effectiveness/dissatisfied) to 5 (excellent effectiveness/very satisfied). The mean system effectiveness was 4.22 (with a standard deviation of 0.63), and the mean satis-

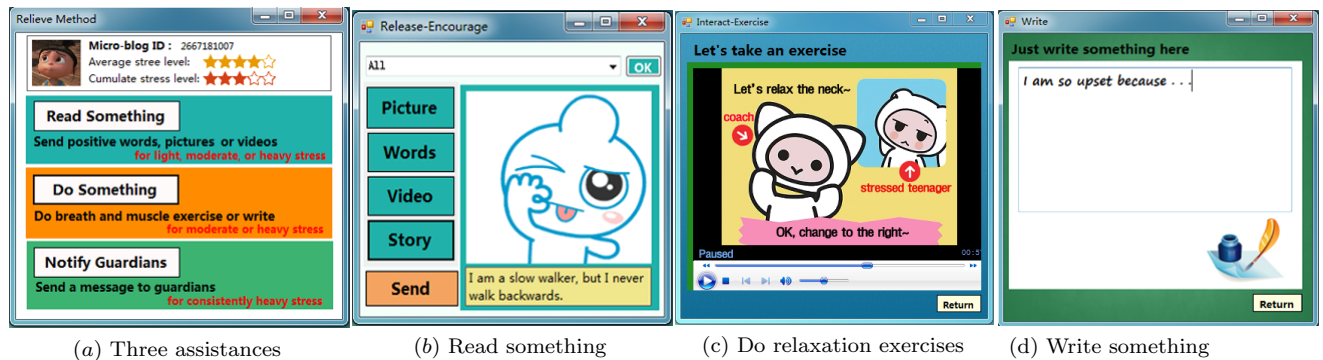


Figure 2: Assisting teenagers to relieve pressures

fraction for the system was 4.67 (with a standard deviation of 0.47). Such results suggests that our system performs well at detecting and relieving adolescent psychological pressures.

## 5. DEMONSTRATION PLAN

During the demonstration, attendees will be invited to interact with *tHelper* to sense and help relieve the pressure of a teenager from his/her micro-blog tweets. To walk through the functionalities of *tHelper*, we choose a volunteer named Michael on micro-blog from the lab as an example.

*Input Sensing Requirement.* In the main interface page, we choose the first option to sense the possible pressure of Michael. Then we enter the **Personal Information** page (Fig 1(a)). In this page, we first choose the sensing period from 2013/9/15 to 2013/10/15. The bottom of the page shows Michael's detailed information on micro-blog. We click the button **Sense** to start the pressure sensing process.

*Sense and Visualize Sensed Result.* After the **Sense** button is clicked, the system grabs the tweets posted by Michael in the identified time period, and then the sensing algorithm starts analyzing the tweets. The sensed pressures of Michael are shown in **Sense Result** page (Fig 1(b)). From the broken line chart, we can see his stress changing trend of four categories respectively, among which the academic stress line is at the highest level and fluctuates obviously. Detailed results are given in the pie chart at the bottom, showing his main stress coming from the *academic* category with a a four-star average stress level and a three-star cumulate stress level. We notice that the system shows a warning and recommends that we help Michael relieve his heavy stress. Then we enter the **Relieve Pressure** page.

*Relieve Pressure.* In the **Relieve Pressure** page, we see three types of assistances - **Read Something**, **Do Something**, and **Notify Guardians** (Fig 2(a)). If selecting the **Read Something** method, a warm-hearted picture in GIF format is randomly chosen from the system repository, followed by a random sentence 'I am a slow walker, but I never walk backward' according to the *academic* stress category (Fig 2(b)). We click the **Send** button. Then a new tweet containing this picture and sentence is posted by the system to Michael via symbol '@+Michael'. Meanwhile, if we select the **Do Something** method since Michael's stress level is high, a cartoon relaxation exercise video URL will be sent to Michael's micro-blog via symbol '@+Michael' (Fig 2(c)).

*Notify Guardians.* To relieve Michael's high stress timely, the system also sends a mobile phone message to his

guardian automatically according to the sensed result, with the content as 'Dear guardian, Michael experiences academic stress from 2013/9/15 to 2013/10/15. Please help him'. Here, the phone number is registered by Michael's guardian beforehand.

After Michael logs in micro-blog, he finds two piece of messages for him, one containing a picture with encouraging words and the other suggesting a relaxation exercise. If he wants to write something (as a reply to these encouraging information) (Fig 2(d)), the system will record it on back-end as a virtual emotional diary for Michael.

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