Exploratory Analysis of Emotions in Computer Engineering

Jiaming Xu
jm.xu@mail.utoronto.ca
1007698831, Group 8, Department of ECE, University of Toronto
Toronto, Ontario, Canada

Teng Yue
teng.yue@mail.utoronto.ca
1007826792, Group 8, Department of ECE, University of Toronto
Toronto, Ontario, Canada

Wenrui Xu
wenrui.xu@mail.utoronto.ca
1008313228, Group 8, Department of ECE, University of Toronto
Toronto, Ontario, Canada

ABSTRACT

This report mainly discussed the impacts of different emotions may have on coding efficiency. We use both quantitative and qualitative analysis to find the results. For the quantitative analysis, we investigate the open-source repositories, mine the emotion hidden inside the commit messages and find the relationship between emotion and coding efficiency. For the qualitative analysis, we make some interviews with software engineers from dot-com companies, research teams and open-source community. Besides, some participants also shared their project emotional experience on other engineer-related approaches, which indicates some general clues of emotion impacts in computer engineering.

KEYWORDS

Emotion Mining, Working Efficiency, Psychology, Computer Engineering

1 INTRODUCTION

With the continuous development of the social economy, the development of software engineering technology has made people's lives more convenient, and has also driven the development of many other industries. Also with the wide application of various software, people pay more and more attention to software engineering technology, and its practical application scope is also expanding. In order to meet people's requirements for high-quality life, software engineering technology must accelerate its development. Demand and development promote each other, making the software development industry continue to innovate. The newly generated technology also provides many jobs for society. At the same time, the software development department has a growing voice in Internet companies. More and more company managers are developed from the original junior or senior software engineers in the company. Many companies also set generous benefits and salaries for software engineers.

However, behind the exquisite web pages, complex and diverse software functions and decent salaries are the sweat and day-and-night hard work of software engineers. While well-paid, many software engineers are under pressure. Because Internet companies have put forward requirements for software engineers to work efficiently when developing software, it is necessary to compress the development time of software systems to minimize the development cycle of software. In the process of software development, iterative development has become an important content, which requires software engineers to have stronger testing capabilities and coordination capabilities. This places high demands on the software engineers' ability to adjustment, iterative development, and teamwork. Being in a state of high stress for a long time, developers are also very easy to become anxious and depressed.

In order for the company to have a strong competitiveness, Internet companies require employees to maintain high work efficiency. Additionally, in order to ensure the mental health of employees, a lot of companies have begun to pay attention to the mental health of employees. Some Internet companies regularly hold departmental activities to enhance the relationship between teams. A few Internet companies even set up special psychological counseling rooms for employees to relieve psychological pressure.

However, few previous papers have specifically explored the relationship between software engineer emotions and productivity. Indeed, there are a few papers discussing the relationship between positive mood and work efficiency. But the participants are not software engineers, and the research results may not be applicable to the field of software engineering. In addition, the relationship between positive and negative moods on work productivity has rarely been explored simultaneously.

Therefore, in this study, we intend to explore the relationship between software engineers' emotions and their productivity. First of all, on the basis of extensive reading and understanding of the related literature, we present the research status of the research field, including the main academic viewpoints, previous research results, focus of debate, existing problems and possible reasons, etc. We also conduct comprehensive analysis, summarization and comments on previous literature. Then, we will exploit both quantitative and qualitative method in our research, including an emotion mining and interviews respectively.

The rest of the paper will be presented as follows: section 2 presents the literature review pertaining to emotions model and emotion mining. Section 3 presents the research questions. Section 4 presents how we collect and analyze data in both quantitative and qualitative ways. Section 5 presents the process of conducting emotion mining. Section 6 presents how we conduct interviews.

2 LITERATURE REVIEW

In this section, we introduce emotion models and the emotion mining method we learned in the literature review.

2.1 Emotion Models

For more than half a century, basic emotion theory has been explored and disputed, propelling the field of emotional psychology forward. The basic emotion model proposes that humans have a limited set of biologically and psychologically "basic" emotions (e.g., fear, anger, joy, and sadness) [**?**], each displayed in an orderly recurring pattern of linked behavioral components [**?**] [**?**].

Even though many psychologists have accepted the theory of basic emotions, there is no consensus about the precise number of basic emotions. Robert Plutchik offered eight fundamental emotions, which he organized into a color wheel: anger, fear, sadness, disgust, surprise, anticipation, trust, and joy. Fear, anger, joy, sadness, contempt, disgust, and surprise were presented as seven basic emotions by Ekman, but he altered it to six basic emotions: fear, anger, joy, sadness, disgust, and surprise [**?**]. According to Jack et al. [**?**], humans have four primary emotions: fear, anger, joy, and sadness.

In this paper, we apply Parrott's basic emotion model [**?**], which consists of six basic emotions, which are love, joy, surprise, anger, sadness and fear respectively. Beside the six basic emotions, they can be subdivided into secondary emotions. Meanwhile, the secondary emotions can even be subdivided into tertiary emotions. In our search, we only apply the six basic emotions, but will try the secondary emotions in future study.

2.2 Emotion and productivity

Many literatures have shown the influences of emotions.

Positive emotions and moods, according to Barsade et al. [**?**], tend to improve performance at the individual, group, and organizational levels. Furthermore, they claimed that negative affective expressions can contaminate organizational cultures, influence leaders' perspectives, and potentially lead to aggressiveness or violence. Negative emotions (particularly rage) might, on the other hand, attract our attention to situations of injustice and unfairness, strengthen power perceptions, and improve bargaining outcomes.

Better mood actually affects worker productivity for workers whose compensation is mainly stable, according to Decio Coviello et al [**?**]. For workers whose pay is dependent on performance, the negative effects of mood are reduced (high-powered incentives).

By analysing on-the-job emotionality, Yoshihiko Kadoya [**?**] et al. investigated the link between workers' emotional states and productivity. Happiness was found to be strongly and positively associated to productivity, according to their findings. Such findings suggested that, in order to assure improved productivity, workers' emotional states should be handled as part of an organization's operational strategy.

M. Ali Pervez [**?**] found that workplace emotions were only regarded important in terms of employee well-being and job satisfaction. Anger frequently leads to aggressiveness toward coworkers, whereas sadness leads to job discontent. An emotion, such as rage, interest, or trust, is neither instantaneous, nor is it long-lasting like a mood; rather, it is a brief event of coordinated changes in mind and body that has a direct impact on the employee's performance.

2.3 Emotional Mining

Emotion mining is a quantitative method. Many previous papers have applied such approach in the data analysis process.

Jinxuan Zhou et al. [**?**] demonstrated a new approach for mapping designer emotions and accompanying designer activities in synchronous collaborative CAD using automated facial emotion detection software and cursor tracking. Designers who worked in a paired workflow showed more emotion than designers who worked alone, according to their findings. In their technique, logistic regression was used to analyse the correlations between user actions and feelings for each combination of event and emotion for each participant, and meta-regression was used to aggregate the regression results for the two different working styles.

Mohamed Yassine et al. [**?**] proposed a new paradigm for defining emotional interactions in social networks and then separating friends from acquaintances based on these qualities. A model for data collecting, database schemas, data processing, and data mining stages are all included in the framework. The goal was to see if the writer's writings conveyed his or her thoughts and feelings. The data was then employed to determine the strength of a relationship between two people based on the subjectivity of the texts they shared online. A k-means algorithm was used to divide the texts into three categories. The first category included objective or factual communications, the second moderately subjective writings implying some form of relationship between the users, and the third category included subjective texts implying a deep friendship between the two users.

3 RESEARCH QUESTIONS

There are a number of research questions we plan to figure out through the research.

- How do we define and categorize different kinds of emotion?
- How do we know engineers' emotion from their codes?
- How do we measure the efficiency of coding?
- Does the emotion change have impact on the efficiency of coding?
- What effects will the emotion change cause on coding efficiency?

4 METHODOLOGY

We will collect and analyze our data in both qualitative and quantitative ways.

4.1 Study 1: Emotion Mining

We design a data mining method to do the quantitative analysis and predict the emotions hidden in open-source repositories' commit messages. Using the predictions and evaluation of the commit log, we try to find the relationship between emotions impacts and working efficiency in open-source projects. We divide the experiment design into two parts, including emotion prediction and working efficiency evaluation.

4.1.1 Emotion Prediction. In this section, we will talk about our plans for emotion predictions. We plan to use text emotion mining for this part. We will take the commit messages and their description as raw data for us to do the data mining. There are several phases in our plan. For the first step, we will select a repository in which the commit messages tend to show a strong emotion. We will take it as an example, and do the analysis and prediction on this repository to form the basic results and conclusions. We will use the regular expressions filter to label the emotions within the commit information. It's easier for us to deploy it and costs less. Every commit log which contains the emotion related words will

be recorded in our local files. Then we will try to apply more complex methods to the repository. For example, we can use the convolutional neural network to build and train a model to predict the emotions within the commit messages. The comparison between these two methods will be discussed later. At last, we will validate our observation and insights derived from the example project to other repositories.

4.1.2 *Working Efficiency Evaluation.*

4.2 Study 2: Semi-structured Interview

We design a semi-structured interview to do qualitative study to explore the relationship between emotion impacts and coding efficiency on the subjective perspective. Besides, we also tried to figure out the potential factors which influence the emotional status of people during the project in order to give suggestions with reference values to both employers and team leaders.

Since the interview aims on evaluating influence, express and outcome factors, we propose several types of factors which we will focus on in the interview designing and analysis. For the influence factors, we searched some typical reasons and did brief talks with some engineers other than the participants, we finally introduce the following influence factors:

- Project Factors
- Social Factors

TODO

We plan to interview 10-20 participants from different regions about their project experience. We will ask question to investigate their emotion status along the project working procedure, and infer the internal and external factors leading to their emotion status correspondingly. Our participants should comprise of software engineering related people from different specific divisions, for example, machine learning, backend developing, quality assurance engineering, UI/UX designing and etc. To achieve in more general and comprehensive conclusion, we also select participants from our own social network and engineer community, including employees at different degrees in Internet companies, graduate students, and open-source developers.

TODO

5 EMOTION MINING

5.1

6 INTERVIEW

Practically, we recruit 16 participants overall from diverse regions, status of employment and division background. For the composition of respondents, 11 of them are from East Asia and 5 are from North America, while 9 of the participants choose not to disclose the full scripts of interview due to contents involving confidential issues, and rest of the scripts are included in the repository of our project on GitHub.

All the participants are currently or formerly engineering occupied, and they may or may not share their experience in engineering related or unrelated divisions. For the further evaluation and analysis, we asked participants for permission to record audio

Table 1: Composition of Participants

Employment Status	Number of People	Perception
Graduate Student	4	25%
Junior Engineer	4	25%
Senior Engineer	3	18.75%
Open-source Developer	5	31.25%
Overall	16	100%

7 DISCUSSION

8 LIMITATIONS

9 CONCLUSION

10 ACKNOWLEDGEMENT

11 FUTURE WORK