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Finding Anxiety Based on On-line Communication in Internet

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Abstract

Psychological anxiety is threatening people's health. It is non-trivial to detect anxiety timely for proactive care. With thepopularity of on line media, people are used to sharing their daily activities and interacting with friends on on line media platforms, making it feasible to leverage online on line network data for anxiety detection. In this paper, we find that users anxiety state is closely related to that of his/her friends in on line media, and we employ a large-scale dataset from real-world on line platforms to systematically study the correlation of users' anxiety states and on line communication. We first define a set of anxiety-related textual, visual, and on line attributes from various aspects, and then propose a novel hybrid model - a factor graph model combined with Convolutional Neural Network to leverage tweet content and on line interaction information for anxiety detection. Experimental results show that the proposed model canimprove the detection performance by 6-9 percent in F1-score. By further analyzing the on line interaction data, we also discover several intriguing phenomena, i.e., the number of on line structures of sparse connections (i.e., with no delta connections) of anxietyed users is around 14 percent higher than that of non-anxietyed users, indicating that the on line structure of anxietyed users' friends tend to be less connected and less complicated than that of non-anxietyed users.

Index Terms: Anxiety detection, factor graph model, micro-blog, on line media, healthcare, on line interaction

1. Introduction

Psychological Anxiety is Becoming a Threat to People's Health Nowadays. With the rapid pace of life, more and more people are feeling anxieties. According to a worldwide survey reported by New business in 2010,[1] over half of the population have experienced an appreciable rise in anxiety over the last two years. Though anxiety itself is non-clinical and common in our life, excessive and chronic anxiety can be rather harmful to people's physical and mental health. According to existing research works, long-term anxiety has been found to be related to many diseases, e.g., clinical depressions, insomnia etc.. Moreover, according to Chinese Center for Disease Control and Prevention, suicide has become the top cause of death among Chinese youth, and excessive anxiety is considered to be a major factor of suicide. All these reveal that the rapid increase of anxiety has become a great challenge to human health and life quality.

Thus, there is significant importance to detect anxiety before it turns into severe problems. Traditional psychological anxiety detection is mainly based on face-to face interviews, self-report questionnaires or wearable sensors. However, traditional methods are actually reactive, which are usually labor-consuming, time-costing and hysteretic. Are there any timely and proactive methods for anxiety detection?

The Rise of On line Media is Changing People's Life, as Well as Research in Healthcare and Wellness. With the development of internet like Twitter more and more people are willing to share their daily events and moods, and interact with friends through the internet. As these on line media data timely reflect users' real-life states and emotions in a timely manner, it offers new opportunities for representing, measuring, modeling, and mining users behavior patterns through the large-scale internet, and such on line information can find its theoretical basis in psychology research. For example, [7] found that anxieties users are more likely to be on line less active, and more recently, there have been research efforts on harnessing on line media data for developing mental and physical healthcare tools. For example, [27] proposed to leverage Twitter data for real-time disease surveillance; while [35] tried to bridge the vocabulary gaps between health seekers and providers using the community generated health data. There are also some research works [28], [47] using user tweeting contents on on line media platforms to detect users' psychological anxiety. Existing works [28], [47] demonstrated that leverage on line media for healthcare, and in particular anxiety detection, is feasible.

Limitations Exist in Tweeting Content Based Anxiety Detection. First, tweets are limited to a maximum of 140 characters on on line platforms like Twitter and facebook, and users do not always express their anxietyful states directly in tweets. Second, users with high psychological anxiety may exhibit low activeness on internet, as reported by a recent study in Pew Research Center.[3] These phenomena incur the inherent data sparsity and ambiguity problem, which may hurt the performance of tweeting content based anxiety detection performance.

Users' On line Communication on Internet Contain Useful Cues for Anxiety Detection. On line psychological studies have made two interesting observations. The first is mood contagion [37]: a bad mood can be transferred from one person to another during on line interaction. The second is linguistic echoes [34]: people are known to mimic the style and effect of another person. These observations motivate us to expand the scope of tweet-wise investigation by incorporating follow-up on line communication like comments and retweeting activities in user's anxiety detection. This may actually help to mitigate the single user's data sparsity problem. Another reason for considering on line communication in anxiety detection is based on our empirical findings on a large-scale dataset crawled from Facebook that the on line structures of anxiety users are less connected and thus less complicated than those of non-anxiety users. This is consistent with the Pew Research Center's finding that anxiety users are less active than non-anxiety ones. The bottom of Fig. 2 illustrates four on line interaction structure patterns. Each node in a structure pattern represents a user's interacting friend (who either commented or retweeted the tweets). If two nodes are also friends on on line network, there is an edge linking both; otherwise, there is none. We examined 500 users on facebook. For each user, we collected and merged his/her one week tweets into one and sense anxiety from it. Meanwhile, we captured the top-3 most active friends the user interacted with. As shown in Fig. 2, anxiety users' interaction structures are less connected, and thus less complicated than those of non-anxiety users.

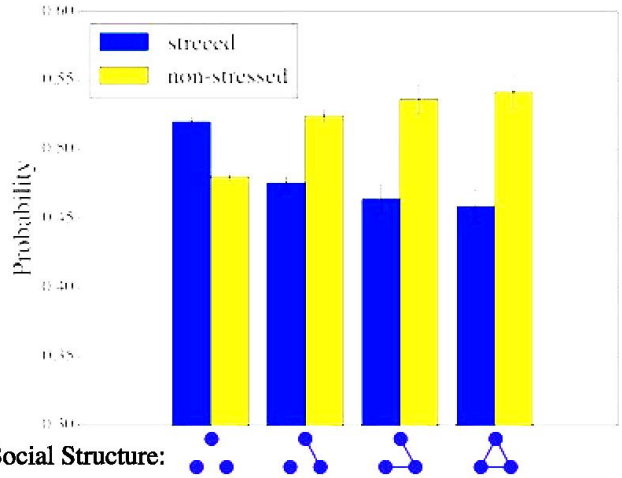

Fig. 1: The sampling test results of the diversity of users' on line structures from Facebook, by using the top 3 interacted friends of the users.

2 RELATED WORKS

Psychological anxiety detection is related to the topics of sentiment analysis and emotion detection.

Research on Tweet-Level Emotion Detection in Internet. Computer-aided detection, analysis, and application of emotion, especially in internet, have drawn much attention in recent years [8], [9], [28], [41], [52], [53]. Relationships between psychological anxiety and personality traits can be an interesting issue to consider [11], [16], [43]. For example, [1] providing evidence that daily anxiety can be reliably recognized based on behavioral metrics from users mobile phone activity. Many studies on on line media based emotion analysis are at the tweet level, using text-based linguistic features and classic classification approaches. Zhao et al. [53] proposed a system called MoodLens to perform emotion analysis on the Chinese micro-blog platform Weibo, classifying the emotion categories into four types, i.e., angry, disgusting, joyful, and sad. Fan et al. [9] studied the emotion propagation problem in internet, and found that anger has a stronger correlation among different users than joy, indicating that negative emotions could spread more quickly and broadly in the network. As anxiety is mostly considered as a negative emotion.

Research on User-Level Emotion Detection in Internet. While tweet-level emotion detection reflects the instant emotion expressed in a single tweet, people's emotion or psychological anxiety states are usually more enduring, changing over different time periods. In recent years, extensive research starts to focus on user-level emotion detection in internet [29], [36], [38], [50]. Our recent work [29] proposed to detect users psychological anxiety states from on line media by learning user-level presentation via a deep convolution network on sequential tweet series in a certain time period. Motivated by the principle of homophily, [38] incorporated on line relationships to improve user-level sentiment analysis in Twitter. Though some user-level emotion detection studies have been done, the role that on line relationships plays in one's psychological anxiety states, and how we can incorporate such information into anxiety detection have not been examined yet.

Research on Leveraging On line Communication for On line Media Analysis. On line interaction is one of the most important features of on line media platforms. Now many researchers are focusing on leveraging on line interaction information to help improve the effectiveness of on line media analysis. Fischer and Reuber [12] analyzed the relationships between on line communication and users' thinking and behaviors, and found out that Twitter-based interaction can trigger effectual cognitions. Yang et al. [49] leveraged comments on Flickr to help predict emotions expressed by images posted on Flickr. However, these work mainly focused on the content of on line communication, e.g., textual comment content, while ignoring the inherent structural information like how users are connected.

CONCLUSION:

Two challenges exist in psychological anxiety detection.

1) How to extract user-level attributes from user's tweeting series and deal with the problem of absence of modality in the tweets?

2) How to fully leverage on line interaction, including interaction content and structure patterns, for anxiety detection?

To tackle these challenges, we propose a novel hybrid model by combining a factor graph model with a convolutional neural network (CNN), since CNN is capable of learning unified latent features from multiple modalities, and factor graph model is good at modeling the correlations. In this section, we will first introduce the architecture of our model, and then describe the details of each part of the proposed model.

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