Exploring the relationship of Generalized Anxiety Disorders, Depression, Written Texts and Personality Traits among Chinese University Students

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Exploring the Relationships of Generalized Anxiety Disorders, Depression, Written Texts and Personal Traits Among Chinese University Students

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Executive Summary

Mental illness account for 30% of non-fatal disease burden worldwide, however, the health budget assigned to mental illness is disproportionately small, especially in low-income or developing countries (Mnookin et al., 2016), which means fewer patients with mental problems in developing countries get timely consultation and treatment compared with patients from developed countries. To improve the efficiency and reliability of people being diagnosed with mental illness and getting treatment, several studies have focused their attention on other branches of psychology, like personality psychology. Dating back to the 18th century, personality traits were already related to anxiety disorders (Costa Jr & McCrae, 1992). The fundamental way to recognize individual differences in personality is to look at the styling of the sentence (Pennebaker & Graybeal, 2001). The words people use in their daily life reflect who they are and the social relationships they are in. Therefore, by using more natural and indirect way-detecting peoples' personality traits and their natural language, might get a more reliable knowledge of their mental conditions.

China, as a representative of undeveloped countries but with a large population, has too few epidemiological data on mental disorders, including GAD and Depression (Ma et al., 2009). Besides, Chinese university students' mental conditions are not good, after the most important examination in their life and with more social relationships to cope with, but are ignored. In addition, current research, to identify GAD and Depression from natural language, and explore the relationship between personality and GAD and Depression, has until now not been conducted in the Chinese language. Therefore, this research is to explore the relationships between GAD, Depression, natural language and personality traits among Chinese university students, which might help increase the understanding into the prevalence of GAD and Depression among Chinese people and help in establishing a quicker diagnosis of GAD and Depression in the future.

To reach the objective of the present research, an online survey was conducted among Chinese university students, which consists of GAD-7, PHQ-8, BIS/BAS, and PANAS questionnaires, followed by a writing task to describe their feelings about university life and one anxious moment happened in the university. Finally, demographics were assessed, In total, 243 responses were collected, of which 99 were men and 144 were women (87.24% of them fall into the age range of 18-25). 27 were excluded from the sample because of problems with the answers to the writing task, Therefore, the final sample used in the present study included 216 participants, of which 91 were men and 125 were women.

All the sample data were exported into .csv format and imported into the software JASP (JASP, 2017). And the text of the writing task was uploaded on LIWC 2022 software (LIWC, 2022) package, and on the statistical software SPSS for additional analyses. The analysis results include the percentage of Chinese university students with or without GAD and depression, descriptive statistics and correlations of the GAD-7, PHQ-8, BIS/BAS, and PANAS, descriptive LIWC results, and correlations of LIWC, GAD and PHQ-8 under the impact of BIS/BAS and PANAS respectively.

Through the experiment, the main Research Question was answered. The written texts provided by Chinese university students differentiated between students high or low on GAD and depression, and these texts differ based on students' personality traits. In general, Chinese university students' linguistic patterns reflect whether they have GAD and Depression, and also show their personality traits. Besides, some new linguistic findings were identified in the experiment. The first one is the correlation between BIS and past-focused verbs. Chinese university students high on BIS use more past-focused verbs than those low on BIS. And the second one is the positive relationship between BAS and leisure-related expressions. Students who are high on BAS use more leisure-related expressions than those who are low on BAS. Besides, personal pronouns were identified as important signals to differentiate Chinese students with or without GAD, but no

significant distinction was found between the first personal pronoun and the second personal pronoun, which is different from most previous studies.

Because the present research is an extended study of Chiara Mazza's work (Mazza, 2020), which was conducted among Western university students. Therefore, it's straightforward to compare the results of Chinese university students and Western university students. The percentage of Western university students having GAD is more than double than for Chinese university students with GAD, the main explanation might be the addition-honesty-humility in the HEXACO. And the correlations of LIWC categories of the Dutch, Italian, and Chinese samples suggested that the nationality affected the linguistic patterns of students with GAD.

By reflecting on the whole thesis, some limitations could be paid more attention to have better future research.
(1) The participants were all university students, which made the findings from this study may not generalize to the wider population. (2) Cultural factors make Chinese people reluctant to face their true selves. (3) The survey was completely conducted online, as a result of which the lace and circumstances of the participants could not be monitored. And a big suggestion for future work is to incorporate the Zimbardo Time Perspective Inventory (ZIPI) to confirm and double-test the time perception of participants.

In conclusion, the present research highlights that the written texts differ between Chinese university students with or without GAD/depression, and further these texts also differ based on their personality traits.

Preface

Looking back on the past two years, neither school nor life has been an easy journey. When I started my first Master's course at TU Delft, I was struggling to keep up with the teacher and understand unfamiliar concepts. And at that time, teamwork and group discussions put more pressure on me. I had to communicate with classmates from different backgrounds, which was such a difficult 'task' for an ill-spoken person. I was then in a state of anxiety and even wanted to give up my study. However, with the encouragement of my friends and my family, I stuck with completing all courses. Regardless of grades, I am proud of myself. And I sincerely thank all the professors and classmates I met. Just because of them, I had the chance to see a bigger world and reach out to so many people with interesting and profound perspectives. And just because of them, we could complete so many challenging projects.

Now while making the final adjustments to my master thesis in the middle of the night, I keep recalling the whole process of this half year. At first, I was very afraid to reach out to find supervisors because of my not good spoken and written English. Until now I still feel so lucky to have Dr. Laurens Rook as my first supervisor. He is such a patient man who is willing to hear all my ideas even though I expressed them not very easy to understand. Every document I submitted to him would get his positive comments and careful corrections, which helped me a lot especially when I faced difficulties. I can't be more thankful for all his help throughout the whole process.

My thank also goes to Prof. dr. Frances. M. Brazier and Dr. Iulia Lefter. Since the first meeting, they have given me so many helpful suggestions and pointed me in the right direction. Even though in their holiday time, they agreed to attend my Green Light and Defense meeting.

My thanks also go to my family for all the love and support. They support me to study abroad and offer all the things I need. An important thing I learned is that family care for you most whoever you are and wherever you most. Especially I would thank my mom for all the patience and love. No matter what I do, She is always the most supportive person.

Yuxin Xing
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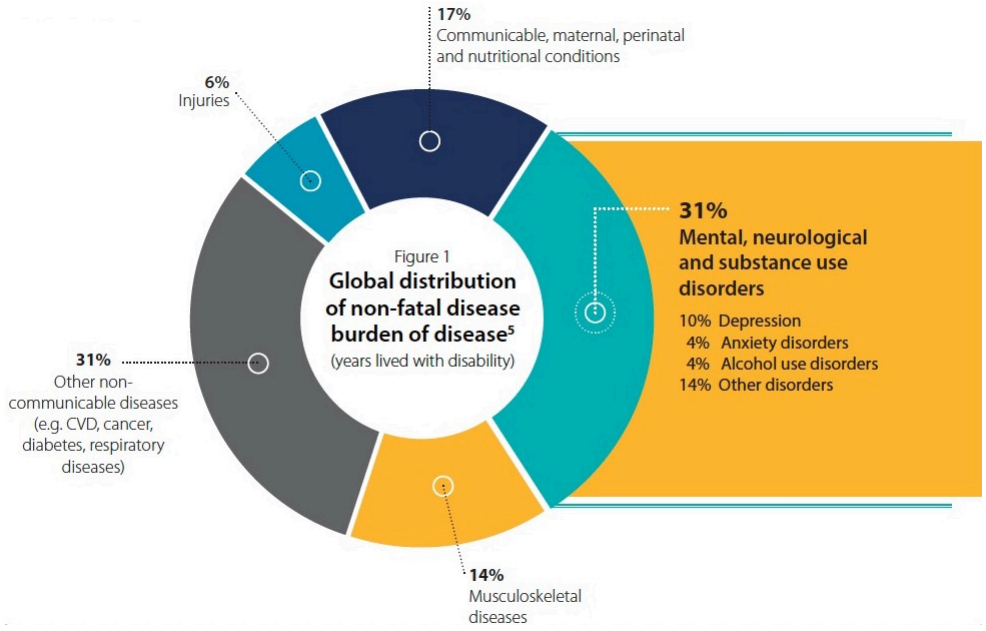
1 Introduction

Nowadays, because of increasing and continuous social and economic pressure, the problem of mental illnesses is much more common in society than in the past (Mayo Clinic, 2019). According to an important report on the global burden of disease, nearly one-fifth of U.S. adults were experiencing some type of mental illness and even one in 24 got serious mental illnesses. Studies on mental disorders around the globe have shown that each year about one third of the adult population suffers from mental disorders (Kessler & Ustun, 2008). Mental illness symptoms can affect one person's emotions, thoughts and behaviors. Some of common symptoms include extreme mood changes of highs and lows, significant tiredness, and inability to cope with daily problems or stress. Even, patients with mental illnesses might develop suicidal thoughts. Moreover, a great deal of money is spent on the treatment of patients with mental illness. Therefore, the prevalence of mental illness places a huge burden both economically and socially. In fact, mental illness account for 30% of non-fatal disease burden worldwide as shown in figure 1 (Mnookin et al., 2016).

Figure 1: Global distribution of non-fatal disease burden of disease



The common types of mental illness include anxiety disorders, mood disorders, schizophrenia disorders and so on. The most common forms of anxiety disorders are Generalized Anxiety Disorder (GAD), Obsessive Compulsive Disorder (OCD), Social phobia/Social anxiety disorder, Post - Traumatic Stress Disorder (PTSD), and Panic disorder. Depression and Bipolar disorder (manic - depressive disorder) are two major types of mood disorders. And for schizophrenia disorders, there are five types we usually see in real life: Paranoid Schizophrenia, Catatonic Schizophrenia, Disorganized Schizophrenia, Residual Schizophrenia, and Undifferentiated Schizophrenia.

Depression, also called depressive disorder, is a common mood disorder. There are many causes that may make one person depressed, like the death of friends or family members, losses of a job and even small events that are upsetting. If the depression continues to be present when stressful events are over or there is no apparent reason for one person being upset,

mental professions would diagnose this person with clinical or major depression (Cleveland Clinic, 2018). Depending on different symptoms, there are also different types of depression: Postpartum depression, which occurs when women are pregnant or after delivering babies; Persistent depressive disorder, a chronic form of depression for at least two years; Psychotic depression, a severe type with psychotic symptoms, such as hallucinations or delusions (Cleveland Clinic, 2018).

According to the study conducted by Somers and colleagues among the common anxiety disorders, GAD had almost the largest number of cases in the same countries surveyed (Somers JM et al., 2006). GAD, also called Generalized Anxiety Disorder, as one of the most common types of mental illness, highly affects mental and physical health, and even leads to suicide tendencies in the absence of timely and correct diagnosis and treatment (Stein & Sareen, 2015). However, according to a report by WHO (World Health Organization & World Bank Group, 2016), GAD and other mental illnesses remain a low priority in most developed and developing countries. On average, only 0.5% of the health budget is assigned to mental health in developing countries while in developed countries the number rises to 5.1%, which is still disproportionately small (Mnookin et al., 2016). This indicates that whether in low-income or high-income countries, most patients suffering from GAD or other mental disorders do not get timely responses and effective treatment from doctors like other common communicable or non-communicable diseases. Therefore, the key to curing a patient starts with a quick and effective diagnosis.

To find out how to identify one person's mental conditions in a more indirect and unnoticeable way, several studies have focused their attention to other branches of psychology, like personality psychology. Dating back to the 18th century, people were already interested in how personality traits relate to anxiety disorders because these relationships could help build a better understanding of the etiology (a branch of medical science related to the causes and origins of diseases), prognosis (the chance of recovery or recurrence), appropriate treatment, and even prevention of anxiety disorders. Moreover, the five-factor model of personality (FFM) was just derived from personality trait psychology to act as a fundamental and universal way of describing one person's personality (Costa Jr & McCrae, 1992). In the FFM, neuroticism represents that one person is likely to experience psychological distress and would express the mood of anxiety, anger and other negative emotions; extraversion means one person is good at socializing; openness reflects the willingness to embrace differences; agreeable is an indication of trust and sympathy; and conscientiousness reflects a strict adherence to principles. Therefore, to identify a person's personality can also be an indirect way to detect this person's mental conditions.

Pennebaker proposed that to recognize individual differences in personality, it is fundamental to look at the styling of the sentence (Pennebaker & Graybeal, 2001). The words people use in daily life reflect who they are and the social relationships they are in. Language is a common way to translate people's internal thoughts and emotions into a form others can understand. Therefore, words and language are important components of psychology. Besides, with the quick development of computers and the Internet, researchers have developed many computerized programs to conveniently measure psychological status from massive text data on daily language, like LIWC (Tausczik & Pennebaker, 2010).

The next sections will introduce the research problem, the research objective reached by answering the research questions, followed by a brief introduction of the structure of this thesis.

1.1 Research Problem

Currently, mental illnesses are universal all over the globe. Many people are suffering from mental problems with negative emotions like anxiety which might affect their daily life. However, as mentioned above, compared with the huge burden of mental illnesses placed on the economy and society, the health budget assigned to mental health is disproportionately small especially in low-income or developing countries (Mnookin et al., 2016). This means that the conditions of patients getting timely consultation and treatment from doctors in developing countries are worse than those in developed countries. Even in underdeveloped countries like China, the epidemiological data on GAD are too few to have sufficient understanding about it (Ma et al., 2009).

University students are a special group of people, who are going through the transition from adolescence to adulthood and facing a lot of challenges on their own, such as leaving home and adapting to a new environment, coping with increased social relationships and erratic living schedules (Peltzer & Pengpid, 2015). Therefore, the pressure from all sides puts a great burden on university students' mind. According to a report from the WHO, in the United States, mental disorders account for nearly one fifth of the total burden of disease for young adults in 2019 (World Health Organization, 2019). Major depression episode (MDE) and Generalized Anxiety Disorder (GAD) are the most prevalent mental disorders among university students (Auerbach et al., 2018; Ibrahim et al., 2013).

For Chinese university students, they, after experiencing the most important examination in their life – the university entrance exam – are faced with the freedom they never have had before, and with more social relationships that they need to cope with. This critical life event must come with a certain level of stress and anxiety. However, the cost of mental disorders can be extremely high in university students. Experiencing depression in this stage for young people can lead to accumulation of negative impact on their future career prospects and social relationships (Aalto-Setälä et al., 2001). Therefore, it is important to raise awareness of mental health among university students and provide students with mental problems with timely consultation and treatment.

In general, as mentioned in the above paragraph, Chinese university students' mental conditions are not good. However, the current studies about Chinese university students' mental disorders are too few to get reliable information. Besides, current research that is to identify GAD/Depression from natural language, and seeks to explore the relationship between personality and GAD/Depression, has until now not been conducted in Chinese language. Not only is the general knowledge of mental conditions lacking, the research to get a quick diagnosis of GAD/Depression from natural language and personality traits is also lacking. Therefore, there is a need to conduct more thorough research into the relationships between GAD/Depression, natural language and personality traits among Chinese university students, to increase the understanding into the prevalence of GAD/Depression among Chinese people. This would help in establishing a quicker diagnosis of GAD/Depression in the future.

1.2 Research Objective

Even if it is predictable that Chinese university students may be in a relatively poor state of mind, the knowledge of mental disorders as well as the research exploring the relationship between GAD, natural language, and personality traits among Chinese university students is lacking. Thus, it is important to conduct research to find out the relationship between GAD, natural language and personality traits among Chinese university students. The outcomes of such research should be compared with previous research conducted among students in the West.

More specifically, the main research objective of this thesis is the following:
To find out whether GAD and Depression can be identified from the natural language of Chinese university students, and to identify if personality differences add value in the screening for GAD and Depression from natural language.

1.3 Research Question

This section will delineate the principal research questions to be able to meet the main research objective of this thesis. To better design the study and to explore the relationships between multiple variables, also a group of sub-questions is listed.

The main research question for the thesis is:
Do the written texts of Chinese university students reflect whether they have GAD and Depression, or not, and whether show their personality traits?

To answer the main research question, the following sub-research questions are defined:
Sub research question 1:
Do the written texts provided by Chinese students differentiate between students high or low scoring on GAD and Depression?
This question is necessary to find out if there are differences in written texts between Chinese students with or without GAD and Depression.

Sub research question 2:
Does the screening of GAD and Depression from written text differ based on the student's personality traits?
This question is to further explore the relationship between written texts and personality traits.

1.4 Research Approach

The main research objective of this thesis is to find out (1) whether GAD/Depression can be identified from written texts of Chinese university students, and (2) to explore when screening for GAD/Depression from written texts while accounting for personality traits. A research method appropriate for this is the natural experiment, in which participants are exposed to the conditions that are determined by nature. In other words, the investigator won't control any factors or parameters of the experiment. The natural experiment is commonly used in the fields of psychology, social science, and political science (Craig et al., 2017). The natural experiment is similar to randomized control trial (RCT), or laboratory experiment. The RCT does not mimic realities of the real word, and often ignores important contextual conditions. As a result, the outcomes are often considered to be unrepresentative in the real world. The natural experiment has become a more popular alternative to explore cause-and-effect relationships. The method was developed by Joshua Angrist, David Card and Guido Imbens who used the natural experiment to study the impact of wages on employment (Card, 1992). They were awarded the 2021 Nobel prize for their methodological contributions.

Moreover, considering that the main objective is to find out relationships between multiple variables of personality, natural language and GAD/Depression, a large number of data need to be collected and analyzed. An online survey will be conducted since it can be delivered to numerous people at any time. To complete the survey, participants will be required to answer several multiple - choice questions and then a writing exercise, which is recommended by Travagin et al. as expressive writing (EW) to act as written emotional disclosure (Travagin et al., 2015). This writing exercise is set up based on the literature and interviews with mental professionals.

In general, the research approach is divided into three phases: (1) preparation for the experiment, (2) survey, and (3) data analysis. During the first phase, the preparation work will be totally completed, such as choosing appropriate multiple - choice questions for the questionnaire and setting up a meaningful open question, which can further disclosure participants' mental conditions. The second phase is entirely dedicated to conducting the survey and collecting data, which will be analyzed in the third phase through the software LIWC and SPSS.

1.5 Research Relevance

As described above, mental health disorders are always placed in the less priority position compared to other communicable and noncommunicable diseases in most developed or developing countries. As a consequence, many people do not get timely diagnosis and treatment, which increases the rates of suicide.

Although some research has been conducted on GAD or Depression in the field of natural language, few studies analyze the effects of GAD or Depression on the use of natural language (written texts) in relation to personality traits. Additionally, most of these studies have been conducted in the West. These findings cannot be directly applied to Asian countries.

Therefore, it is essential to explore the nature of the language - GAD/Depression relationship in Chinese students, and compare these findings with previous results in the West.

1.6 Report Structure

The structure of this thesis will be introduced in this section. **Chapter 1** firstly describes the background of the research, showing why it is necessary to conduct this study. By introducing the research context and current research in related fields, knowledge gap and a research problem is found out. Then to solve this problem, a main research objective and several research questions are addressed. In **Chapter 2,** a large amount of relevant literature on GAD, Depression, personality traits and natural language is introduced. Current research is also be introduced to identify knowledge gap and grasp the importance to conduct this research. **Chapter 3** presents and describes the conceptual model and hypotheses are verified during the experiment. Next, the method and the process to design the text instrument for the experiment are introduced in **Chapter 4**. The data collected is analyzed in **Chapter 5** and the results are showed. This is followed by **Chapter 6**, a discussion about the results. Last, **Chapter 7** summarizes the conclusion derived from the results.

2 Literature Review

This chapter is to introduce the current literature and research concerning GAD,Depression, personality traits and natural language. Reviewing relevant literature can help learn about research background and help find potential knowledge gap.

2.1 Mental Health Disorders

Mental health disorders, in general, refer to bad changes happening in emotion, thinking, behavior, or their combinations. The examples of the symptoms of mental health disorders are: feeling sad or down, confused thinking or reduced ability to concentrate, extreme mood changes of highs and lows, Inability to cope with daily problems or stress, and even suicidal thinking (Mayo Clinic, 2019). When suffering from mental illness, each person might show different symptoms. And it's obvious that the causes of each person getting mental illness are different. In general, mental disorders caused by two factors: intrinsic and extrinsic (environmental) factors (Mayo Clinic, 2019). The intrinsic factors mainly refer to genetic factors. Mental illness is more common in people whose blood relatives have mental disorders. The extrinsic factors are mainly events that may increase the risk of developing mental disorders, such as: financial problems, a loved one's death and traumatic experiences.

In general, if a person's mental conditions are healthy, psychological hints are very likely to help the person cope with stress and relationships with others in a more proper way, and help make choices more rational and more practical. If one person experiences much distress, strike and problems, and doesn't get timely treatment, there is a very high chance to pick up with mental disorders. Because of increasing pressure from work and family, the problem of mental illnesses is much more common in society. According to an important report on the global burden of disease, nearly one-fifth of U.S. adults were experiencing some type of mental illness and even one in 24 got serious mental illnesses. Studies on mental disorders around the globe have shown that in each year about one third of the adult population suffers from mental disorders (Kessler & Ustun, 2008). According to Wittchen et al., among EU citizens, the most prevalent mental disorders are anxiety disorders, specific phobias, social phobias, agoraphobia and panic disorder (Wittchen et al., 2011).

We cannot ignore the effects of mental illnesses on our health. The WHO reported in the action plan 2013-2020 that the rates of people with mental problems suffering from disability and mortality are disproportionate compared to people without mental problems. People with mental disorders have a 40%-60% greater possibility of premature death than normal people. Moreover, the relationship between mental disorders and suicide, which is one of the most common causes of death among young people all over the world, has been demonstrated related to mental disorders. Therefore, timely diagnosis and treatment are necessary.

Mental illnesses have a strong relationship with suicide, especially among young people. Research found that students in higher education are at an age of easily developing mental illnesses. Three-quarters of people with mental illnesses claimed that they had their first mental symptoms before their mid-20s. However, few of them received timely help. According to reports, in the U.S., the majority of students with mental problems does not seek help from professional counseling - neither in their campus counseling centers nor in other mental health clinics (Prince, 2015). They first turn to friends or family members, who would not give them substantial treatment, instead of approaching mental health professionals. The main cause of this universal phenomenon is identified as the stigma attached to mental illnesses. Examples of the stigmatization of mental illness are the portrayal of the malignant nature of mental illness on some images and the frightening treatment process that is posted on social media (Stuart, 2006).

2.2 Depressive Disorders

Depressive disorders are the most common form of mental disorders. Depressive disorders, especially major depressive disorders (MDD), are commonly occurring, seriously impairing mental disorders. Patients who are cured are more likely to get depressive disorders again in the future. The WHO has ranked MDD as the fourth leading cause of disability around the world because of its prevalence and lethal impacts (Murray & Lopez, 1996). About 16.6% of adults around the world have experienced depressive disorders at some stage of their lifetime. And even more than half of patients who recover from depressive disorders will have at least one additional episode again (Avenevoli et al., 2015). A research conducted in 18 countries indicated that the average lifetime and 12-month prevalence in high-income countries were 14.6% and 5.5%, while in low-to middle-income countries the 2 figures were 11.1% and 5.9% (Lim et al., 2018).

Patients who suffer from depressive disorders have some typical psychological, behavioral, and physical symptoms. The table 1 below lists some of these symptoms.

Table 1: The typical psychological, behavioral, and physical symptoms of depressive disorders (Cassano & Fava, 2002)

Psychological	**Behavioral**	**Physical**
Depressed mood	Crying spells	Fatigue
Irritability	Interpersonal friction/confrontation	Leaden feelings in arms or legs
Anxiety/nervousness	Anger attacks/outbursts	Sleeping too little/insomnia
Reduced concentration	Avoidance of anxiety-provoking situations	Sleeping too much/hypersomnia
Lack of interest/motivation	Reduced productivity	Decreased appetite
Inability to enjoy things	Social withdrawal	Weight loss
Lack of pleasure/anhedonia	Avoidance of emotional and sexual intimacy	Increased appetite
Reduced libido	Reduced leisure-time activities	Weight gain
Hypersensitivity to rejection/criticism	Development of rituals or compulsions	Sexual arousal difficulties

Another important feature of depressive disorders is the increased mortality. Depression is the most important risk factor for suicide of which about two thirds occur in depressed patients (Sartorius, 2001). Besides, homicidal and other aggressive behaviors also commonly occur in clinical practice. The substantial disability and mortality of depression has cost governments' a great amount of money. Only in the U.S., $43.7 billion is spent to make up for the disability and mortality every year (Greenberg et al., 1993). Therefore, more interests have been gained in the diagnosis and treatment of depressive disorders in order not only to improve patients' health but also to reduce governments' financial burden.

2.3 Generalized Anxiety Disorders (GAD)

The other common forms of mental disorder, an umbrella term, are anxiety disorders, mood disorders, and schizophrenia disorders. Anxiety disorders can further be categorized into generalized anxiety disorders (GAD), panic disorders (PD), phobias and obsessive-compulsive disorders (OCD), and post-traumatic stress disorder (PTSD). Among them, GAD and PD are the most widespread, with high rates of misdiagnosis. Moreover, GAD is one of the least studied anxiety disorders with the vaguest conception and diagnostic criteria (Rapee, 1991). Specifically, the diagnostic criteria have changed substantially over the past decades, which has hindered the development of diagnosis and treatment of GAD. Thus, even though GAD is common among people, it is difficult to diagnose with high rates of misdiagnosis.

2.3.1 Overview of GAD

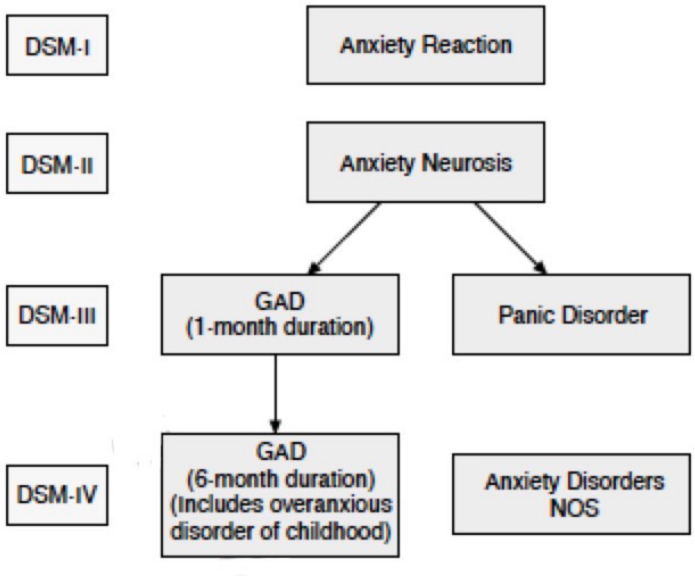


Figure 3:The development of GAD
(Rickels & Rynn, 2001)

The above picture shows the development of the definitions of generalized anxiety disorders (GAD) over time. In the first version of the Diagnostic and Statistical Manual of Mental Disorders (DSM-I), reactions to anxiety were officially listed in mental health disorders. In the second version, 'anxiety neurosis' was separated from the 'neurasthenia', a concept proposed by Sigmund Freud, which was the predecessor of the GAD. GAD was officially defined in the third version of the DSM in 1987 with unclear clinical symptoms and diagnostic criteria. In DSM-IV, the diagnostic criteria of GAD were described as having difficulty in controlling or preventing worry and associated anxiety on more days than not for at least 6 months. The "difficulty" means there are attempts to control or stop worry by cognitive mechanism or overt behaviors, which are not specified in DSM-IV though. Six autonomic hypervigilance or tension symptoms uneasiness, being vulnerable to feel on edge, being easily fatigued, having difficulty in focusing attention, irritability, muscle tension and sleep disorders, were maintained from a long list of automatic symptoms, of which at least three symptoms are required to be diagnosed (Beesdo-Baum et al., 2012).

Behar et al. have summarized 5 contemporary models of GAD based on their conceptual similarities and differences. The five models are the Avoidance Model of Worry and GAD (AMW), the Intolerance of Uncertainty Model (IUM), the Metacognitive Model (EDM), the Emotional Dysregulation Model (EDM), and the Acceptance-Based Model of GAD (ABM) (Behar et al., 2009). The treatment process of GAD, no matter the causes, usually involves psychotropic medications and cognitive behavior therapy (CBT). However, for the diagnosis, things are less clear. Currently, the most common method to assess the GAD is a self-report questionnaire (GAD-7), containing seven questions, of which 0,1,2,3 points are assigned to different answers respectively. After finishing all seven questions, scores of each question are added up and compared to a cut-off point (Spitzer et al., 2006).

2.3.2 GAD Among University Students

University students are experiencing a special stage of their life, from adolescence to adulthood. And the transition to a more complex environment both increase their risk for onset of mental disorders (Auerbach et al., 2018). According to data from the American College Health Association (ACHA), during the period of 1998 to 2008, the prevalence of clinically mental disorders among university and college students was rising over time (Association, 2009). Moreover, the survey, conducted by the association for University and College Counseling Center Directors in 2016, found that among participants, anxiety was the most concerned with an annual prevalence of 51%, followed by depression with an annual prevalence of 41% (Reetz et al., 2016). And because of a variety of sources of stress in college life, such as irregular life schedule and academic pressure, most lifetime mental disorders might happen in a stage of college and would be exacerbated by these pressure (Kessler et al., 2005).

Even if mental disorders are universal problems among university students, the influence can not be taken lightly especially because young people represent the future of a region or even a country. University students would gradually develop into the pillars and leaders of society. Therefore, the development of their mental and physical health is essential (El-Gendawy et al., 2005). Thus, the benefits to improve mental conditions among university students are substantial, for example, rejecting alcohol and substance abuse (Weitzman, 2004), achieving academic success (Kessler et al., 1995) and better dealing with future employment and relationships (Kessler et al., 1995; Ettner et al., 1997).

2.3.3 GAD in China

In developing countries like China and India, mental health, neurological disorders have always been a low priority compared with other communicable or non-communicable diseases. Furthermore, the human and financial resources have been allocated much less than the proportion of burden resulting from mental health disorders (Charlson et al., 2016). In fact, less than 6% of patients with mental disorders get treatment in China. However, as China has the largest population in the world, it is important to do more study about the mental conditions of Chinese people.

2.4 Personality Traits

A person's personality describes behavioral tendencies, habits of thought, which might have influence on this person's future values and perceptions. Personality Psychology is a branch of psychology, in which the influence of personality differences among individuals on their behaviors is studied (Friedman & Schustack, 1999). Some researchers have already identified the direct relationship between personality and mental disorders. Schmutte and Ryff for example revealed connections between the personality and psychological well-being (Schmutte & Ryff, 1997). An experiment in Sweden identified the relationship between late adolescent personality and mental illness among men (Hayes et al., 2017). Therefore, personality traits are important factors to be taken into account in identifying mental disorders (Corr & Matthews, 2020).

The development of personality in the field of psychology has long been dominated by psychoanalysis, social constructivism and statistical indeterminism (Corr, 2004). It wasn't until the neuropsychological theory of personality, now known as Reinforcement Sensitivity Theory (RST), developed by Gray (Pickering et al., 1995; Gray, 1982; Gray & Eysenck, 2017), the importance of personality on psychology got more attention. The RST was developed based on the most influential biological model of personality - Eysenck's biosocial model of personality (Eysenck, 1967), which laid the

necessary foundations for the realization of a neuroscience of personality (Corr, 2004). Eysenck's model described extraversion (E) and neuroticism (N) as the major dimensions of personality. In this theory, Extraversion (E) stated that introverts and extraverts differ in the sensitivity of their cortical arousal system. Compared with extraverts, introverts have lower response thresholds and higher cortical arousal. Intraverts are more cortically aroused and more sensitive to stimulation, while extraverts have lower responses. In other words, when stimulated, introverts are more likely to be startled than extroverts. Neuroticism is related to activation of the limbic system and emotional inability (Eysenck, 1967). Grounded by Eysenck's model, the RST was gradually developed into 3 systems of emotion, the fight/flight system (FFS), that was sensitive to unconditioned aversive stimuli, the behavioral activation system (BAS), that was sensitive to appetitive stimuli, and the behavioral inhibition system (BIS), that was sensitive to conditioned aversive stimuli (Gray & Hinde, 1987).

Recent studies have tended to use BIS/BAS Scales to measure individual differences in sensitivities. Individuals with a highly reactive BIS system are expected to experience high levels of anxiety and to be more cautious, while individuals with a highly reactive BAS system are assumed to display high levels of impulsivity and more risk-taking behaviors (Carver & White, 1994; Vohs & Baumeister, 2016).

2.5 Natural Language

2.5.1 Natural Language for Personality Recognition

Everyone has their own speaking or wring styles even if they discuss the same content. For example, in the 19th century, the frequency of certain words had already been used as an indicator to differentiate soldiers' letters from each other (Broehl & McGee, 1981). The language used can reveal much information about one person and can be considered to measure the person's personality traits.

The relationship between language and personality has been identified in many studies, including lexical categories, acoustic parameters, and more complex phrases. The FFM of personality (or Big Five), for example, originated from studies of personality trait terms in the English language. As for writing style, Gill, by analyzing emails of extroverts and introverts, found that first-person singular pronouns and formal greetings are frequently shown in introvert's emails while informal phrases are more used by extroverts (Gill & Oberlander, 2002).

The way people speak or write is closely related to their personality traits. Therefore, analyzing the language used can better help capture the inherent personality of people. The words used, and the frequency of certain words, will be naturally shown in a person's speaking and writing expressions, which can be a reliable way to anticipate personality traits.

2.5.2 Natural Language for GAD/Depression Recognition

Because personality disorders have strong relationships with mental health disorders, analyzing people's written language is helpful to capture their mental conditions. Since the 1950s, the psychological dimensions of speech and text have been researched, including phrases, thought units, and word choices (Pennebaker & King, 1999).

2.5.3 LIWC

In the 1950s, a content-analysis method was developed by Gottschalk et al. (Gottschalk & Gleser, 1979) to track Freudian themes in text samples. Patients were required to talk into a tape recorder for 5 minutes and the language was then broken down into phrases and evaluated by judges to determine the degree of anxiety. Then a general computerized text analysis program was developed by Philip Stone et al. General Inquirer - which was limited in the manipulation and weighting of language variables(Tausczik & Pennebaker, 2010). Pennebaker found that the words people used could be an indicator to learn about their mental and physiological health, and developed a system - Linguistic Inquiry and Word Count - that is widely used in health psychology (Pennebaker et al., 1997).

Linguistic Inquiry and Word Count (LIWC) is a text analysis program that calculates the percentage of words in a certain text to measure mental attributes, including emotions, personality, and thinking styles. The two most important functions of the LIWC program are the processing function and the comparison of words with dictionaries. As for the processing function, the LIWC program will check each word in the file, compare it with the word in the dictionary file, and calculate the percentage of each LIWC category (like what percentage of words fall into the category ‘adjectives’ or ‘verbals’). The dictionary is a collection of words that belong to different categories, from the original only two to more than eighty categories. Among these categories, various groups of words have clear psychological properties, content words, and style (or function words). Content words, communicated to people the main information of the sentences, generally contain nouns, regular verbs, many adjectives, and adverbs. Style words or function words are mainly pronouns, prepositions, articles, and other categories, which reveal the grammatical relations between content words. Content words reflect the content of what people express, while style words show the way people communicate. Therefore, style words are more closely related to mental properties (Tausczik & Pennebaker, 2010). For example, after suffering from physical or mental pain, people would focus more on themselves, which would result in a higher frequency of first-person singular pronouns (Rude et al., 2004).Interestingly, a Chinese version of the LIWC exists. I plan to use this software package to analyze the text answers from question-and-answer questionnaires collected from Chinese university students to study their personality traits and further to link their written texts to GAD.

3 Conceptual Model and Knowledge Gap

Although some research has been conducted on GAD and Depression level in the field of natural language, few studies analyze the effects of GAD and Depression on the use of natural language (written texts) in relation to BIS/BAS-derived personality characteristics and the Positive and Negative Affect Schedule (PANAS).

As shown in the figure below, this thesis focuses on whether and how Chinese university students affected by GAD and Depression use different expressions compared to students who have stable mental conditions and explore the potential differences between BIS/BAS personality traits and Positive and Negative Affect.

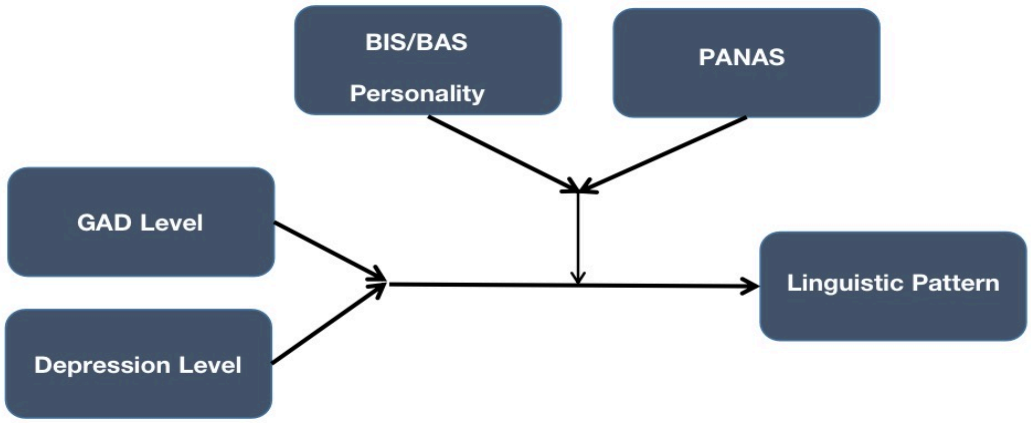


Figure 4: Conceptual Model

The conceptual framework visualizes the relationships and correlations among the five variables of this thesis: GAD level, Depression level, natural language (written texts), BIS/BAS Personality and PANAS. The first two variables (GAD level and Depression level) represent the independent variables, while the third variable (natural language) is the dependent variable. This means that the GAD and Depression level would influence people's writing styles and expressions. Besides, the relationship between independent variables and dependent variables might be altered by the moderating variable - personality traits in this case.

The conceptual framework, around which several research questions and hypotheses are narrowed down to form a complete and worthwhile research, is important to structure the whole thesis. Except for the research questions proposed in the first chapter, several hypotheses can be derived from the conceptual framework to help better understand the research.

HI: Chinese university students suffering from GAD or Depression have different linguistic patterns compared to those mentally stable.

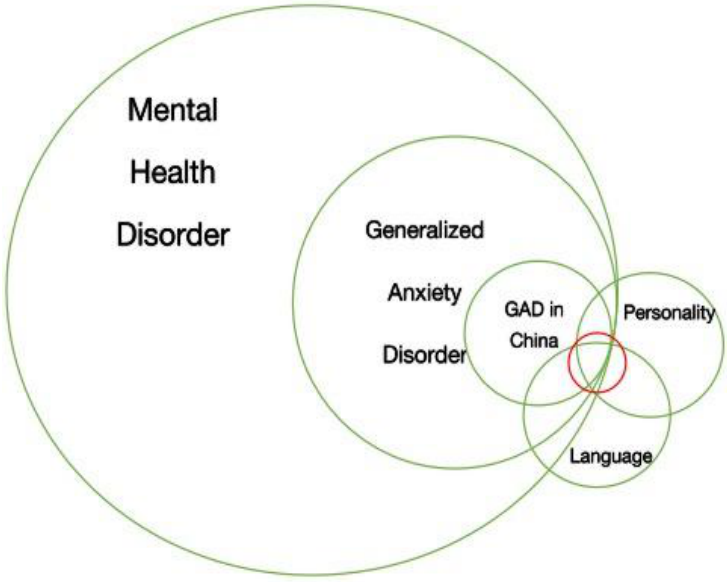
This hypothesis assumes that the GAD and Depression level would affect Chinese university students' writing styles and expressions.

H2: Chinese university students with or without GAD or Depression have different linguistic patterns based on their personality traits.

This hypothesis states that personality traits would also change the way people write and express themselves even if they all have or don not have GAD or Depression.

It is easier to identify the knowledge gap with the help of the conceptual framework. Additionally, most of these studies have been conducted in the Western world. These findings cannot be directly applied to Asian countries. Therefore, the novelty of the research is in the creation of relationships among five variables that had not been investigated jointly until now: GAD level, Depression level, linguistic patterns, BIS/BAS personality and PANAS.

Figure 2:Identified research gap



4 Methodological Approach

This chapter will introduce the methodology used for this research project (including pre-experiment processes, data collection procedure, and data cleaning process). Besides, the scales used in the experiment will be introduced.

4.1 Ethical Approval

The research successfully obtained ethical approval by the Human Research Ethics Committee (HREC) of the Technical University of Delft.

4.2 Participants

This research focuses on identifying mental health conditions and explore the relationships of GAD, personality traits and natural language among Chinese university students. At first, a total of 243 responses was collected, of which 99 were men and 144 were women (87.24% of them fall into the age range of 18-25). However, some issues were found for the open question (to describe their feelings of university life and describe one anxious moment). The table below lists specific reasons why these participants were removed from the sample. The final sample used in the present study included 216 participants, of which 91 were men and 125 were men.

Table 2: Exclusion criteria

The reason why the participants were removed	**Number of the removed participants**	**Examples**
To meet the word limit, they filled this question only with numbers.	7	'1,1,1,1,1'.
They copied and pasted one sentence multiple times.	6	'I have no anxious moments' (entered multiple times).
Their answers are irrelevant to the question.	14	Searched online for the definition of anxiety and wrote it as the answer.
They only commented on their university life but didn't describe their anxious moments.	3	Their answers are only about their feelings for university life.
They didn't meet the word limit.	2	They continued to write periods.

4.3 Procedure

The questionnaire was administered with the Chinese version of Qualtrics, which is open to all. As soon as participants clicked the URL link, an informed consent form would come out, which detailed explain the main objective of the survey and main instructions for participants to follow. Also, participants were informed about their rights each participant had during the completion of the survey and how their data would be used and stored later on. Only if they clicked 'agree' of this informed consent form, the survey would officially start. Participants would first complete personality (BIS/BAS, PANAS), Generalized Anxiety Disorders (GAD-7), and depression (PHQ-8) questionnaires, followed by a writing exercise to describe their feelings of university. Finally, demographics were assessed.

4.4 Measure

4.4.1 Anxiety Scale

The Generalized Anxiety Disorder (GAD-7) questionnaire, a self-report anxiety questionnaire comprising of seven items, designed by Spitzer et al. (Spitzer et al., 2006), was used to identify people's mental health conditions during the previous two weeks and to assess the severity of being affected by anxiety and worrying. Participants were required to select one option out of four, ('*not at all*', '*several days*', *'more than half the days*' and '*nearly every day*'). The scores of each item were summed up and compared with the threshold score of 10. If more than 10, this person was very likely to have GAD, and if less than 10, this person might not be affected by anxiety (Williams, 2014). In this study, the scale was reliable with Cronbach's =0.80.

4.4.2 Depression Scale

The Patient Health Questionnaire (PHQ-8) consists of 8 items and is established as a valid diagnostic and severity measure for depression (Kroenke et al., 2009). Participants were required to indicate how often they have been bothered by symptoms like 'Little interest or pleasure in doing things' and 'Feeling tired or having little energy' over the past two weeks. Each item is given scores of 0, 1, 2 and 3, which represents '*not at all*', '*several days*', '*more than half the days*' and '*nearly every day*' respectively. The scores were summed to obtain scale scores. They cut-off point of PHQ-8 is 10. Thus, if a participant obtains a total score more than 10, he is very likely to be diagnosed with depression. The scale was reliable with Cronbach's =0.87.

4.4.3 Personality Scale

The 24-item BIS/BAS Scales of Carver and White (Carver & White, 1994) were designed to distinguish people's behavioral action system (extraversion and positive affectivity), and behavioral inhibition system, (neuroticism and negative affectivity) (Jorm et al., 1998). Participants had to indicate how much they agree or disagree with what the item says and choose one option out of four, that are '*Very true for me*', '*Somewhat true for me*', '*Somewhat false for me*', and '*Very false for me'*. In total, there were seven BIS-related items, 13 BAS-related items, and the other 4 items were fillers. In this study, the scale was reliable with Cronbach's

4.4.4 Mood Scale

The PANAS, a tool to assess positive and negative affect (Watson et al., 1988), consists of 20 words that describe feelings and emotions. Among all items, 10 items (like interested and excited) are used to measure positive affect, while the other 10 items (like distressed and upset) are used to measure negative affect. Participants had to choose what extent they feel for each item, anchored at '*Very slightly or not at all*', '*A little*', '*Moderately*', '*Quite a bit*' and '*Extremely*' respectively. The PANAS showed adequate convergent and discriminant validity, good internal consistency, and good sensitivity (Díaz-García et al., 2020), and was validated in several languages, including Chinese (Díaz-García et al., 2020). In this study, the Cronbach's for PA and for NA.

4.4.5 Writing task

The writing task for this experiment was in a self-narrative style, in which participants could freely express their feelings without no limitations. This could help participants uncover their real belief and thoughts (Pennebaker & Chung, 2007). The writing task was divided into two parts - feelings about university life, and recall of an anxious moment that has happened in university (McAdams, 2001).

4.4.6 Categories of LIWC

The LIWC software package was used to assess the text participants provided. Moreover, the dictionaries of LIWC have been translated into many languages including Chinese. Therefore, the simplified Chinese dictionary of 2015 version was chosen to detect the words of collected text. The main categories used for analysis were as follows: the specific personal pronouns, the number of words per sentence, and the positive and negative emotions analyzed by Mairesse and colleagues (Mairesse et al., 2007). Some adverbs, swear words and word length were used for previous studies of personality identification (Lee et al., 2007).

5 Results

This chapter shows the main findings from the data and information collected. Explored were the relationships between GAD, depression, personality traits and natural language among Chinese university students.

5.1 Data Cleaning and Processing

All the data from the Chinese version of Qualtrics were exported in .csv format, which could be directly imported into the software JASP (JASP, 2017), the main data-processing tool. The text of the writing task was uploaded on LIWC 2022 (LIWC, 2022) software package, and on the statistical software SPSS for some analyses.

5.2 Pre-Analysis, Descriptive Statistics and Correlations

5.2.1 Pre-Analysis

As discussed in Chapters 4.4.1 and 4.4.2, the cut-off points of the GAD-7 questionnaire and PHQ-8 questionnaire are both 10. That is to say, if the total score of a participant is more than 10, this person is likely diagnosed with GAD or Depression. After summing, the total scores for the GAD-7 and PHQ-8 of 216 Chinese students, 35 (16.20%) of them appeared to suffer from GAD, and 44 (20.37%) of them seemed to suffer from Depression (Table 3). The mean score of GAD was 6.69 (with standard deviation of 3.55), while the mean score of PHQ-8 was 6.52 (with standard deviation of 4.69).

Table 3: The percentage of Chinese students suffering from GAD and suffering from Depression (N = 216)

	With	Without
GAD	16.20%	83.80%
Depression	20.37%	79.63%

Compared with the results of the American association for University and College Counseling Center Director in 2016, that the prevalence of GAD in student participants was 51% (Reetz et al., 2016), 16.20% of Chinese students suffering from GAD seemed to be too low. Besides, Chinese students tend to perform in good but not real directions especially for the things they don't like (Furnham & Chan, 2004), just as the surveys that may uncover their real mental health conditions. Therefore, to double-check whether the GAD results in this study were too low, an alternative measurement, the PROMIS T-score, was used.

PROMIS T-scores, a common metric for anxiety, can construct associations between different measures (Schalet et al., 2014). By converting raw scores of different scales to corresponding PROMIS T-scores, the results can be directly compared. By comparing the trend of PROMIS T-scores for the GAD-7 and the Negative Affect Scale (NA) in this study, we can double-check, whether results of GAD-7 show the real situation of Chinese students in this sample. Figure 5 below shows the PROMIS T-scores and their descriptive characteristics for the GAD and NA in this survey.

Figure 5: Descriptive Statistics of PROMIS T-scores of GAD-7 and NA

	PROMIS T-Score of GAD-7	PROMIS T-Score of NA
Valid	216	216
Missing	0	0
Mean	56.614	61.805
Std. Deviation	6.347	7.981
Skewness	−0.406	0.164
Std. Error of Skewness	0.166	0.166
Kurtosis	0.305	−0.581
Std. Error of Kurtosis	0.330	0.330
Minimum	38.500	43.000
Maximum	71.900	80.200

As the figure shows, PROMIS T-scores of GAD-7 and NA have almost the same general trend, including their mean scores and the boundaries (minimum scores and maximum scores) of PROMIS T-scores. Even though the scores of NA produced a slightly higher PROMIS T-score than for the PROMIS T-score computed from the GAD-7, the results of GAD-7 among Chinese university students can be trusted.

5.2.2 Descriptive Statistics

According to the descriptive characteristics (Figure 6) of the GAD-7, PHQ-8, BIS/BAS, and PANAS, including their mean scores, skewness, and kurtosis, there are no problems regarding collected data: all variables were normally distributed.

Figure 6: Descriptive Statistics

	BAS	BIS	GAD	PHQ-8	Positive Affect Score	Negative Affect Score
Valid	216	216	216	216	216	216
Mean	39.250	18.208	6.690	6.519	37.704	26.718
Std. Deviation	5.080	4.199	3.554	4.687	8.356	9.247
Skewness	−0.214	−0.486	0.363	0.841	−0.740	0.364
Std. Error of Skewness	0.166	0.166	0.166	0.166	0.166	0.166
Kurtosis	−0.232	−0.287	−0.392	0.401	−0.367	−0.946
Std. Error of Kurtosis	0.330	0.330	0.330	0.330	0.330	0.330

5.2.3 Correlation

Figure 7 displays a correlation matrix for the variables in the study, GAD-7, PHQ-8, BIS/BAS and the PANAS. There are several findings that need to be emphasized. First, PA is significantly and negatively correlated with BIS, while NA is significantly and negatively correlated with BAS. Also, NA is significantly and positively correlated with BIS. This finding is in harmony with previous study that BAS links to positive activities while BIS links to negative activities (Jorm et al., 1998). Second, there is a significant and negative relationship between GAD-7 and BAS, and a significant and positive relationship between GAD-7 and BIS.

Figure 7: Correlation Matrix

Variable		BAS	BIS	Positive Affect Score	Negative Affect Score	PHQ-8	GAD
1. BAS	Pearson's r	—					
	p-value	—					
2. BIS	Pearson's r	0.139*	—				
	p-value	0.042	—				
3. Positive Affect Score	Pearson's r	0.019	−0.581***	—			
	p-value	0.787	< .001	—			
4. Negative Affect Score	Pearson's r	−0.406***	0.429***	−0.280***	—		
	p-value	< .001	< .001	< .001	—		
5. PHQ-8	Pearson's r	−0.483***	0.114	−0.332***	0.519***	—	
	p-value	< .001	0.096	< .001	< .001	—	
6. GAD	Pearson's r	−0.401***	0.332***	−0.344***	0.608***	0.722***	—
	p-value	< .001	< .001	< .001	< .001	< .001	—

* p < .05, ** p < .01, *** p < .001

For the PHQ-8, it also has a significant negative relationship with BAS, but no significant relationship with BIS. These findings also response to previous views that BAS and BIS are link with positive and negative activities respectively (Jorm et al., 1998). Then, for the relationships of PANAS, GAD and PHQ-8, PA has a significant and negative relationship with GAD, as well as a significant and negative relationship with PHQ-8. Likewise, NA has significant and positive relationships both with GAD-7 and PHQ-8. Last, a strong positive and significant relationship is identified between GAD-7 and PHQ-8. In other words, comorbidity has been observed between

GAD-7 and PHQ-8. This finding is in line with the finding from a survey conducted by the WHO around the globe that 41.6% individuals with 12-month major depression also had one or more anxiety disorders (Kessler et al., 2015).

5.3 LIWC Categories

5.3.1 Descriptive LIWC Analysis

A descriptive analysis of LIWC categories is shown in the figure below, which summarizes the number of words per sentence, the number of words longer than six letters, and the word density of each category in the sample and the software norms, as well as the abbreviation and the examples of all categories. These LIWC norms come from mean values and mean standard deviations from the text collected from a variety of studies, which include 37295 blogs, 6179 expressive writing, 875 novels, 3232 natural speeches, 34929 NY Times articles, and 35269 Twitter posts (Pennebaker et al., 2015). Since these values of the LIWC norms are averaged over a certain sample, the values in this study may slightly differ from the values of the LIWC norms

Figure 8: Descriptive LIWC Results

Categories	Abbrev	Examples	Word Density of the Sample	Word Density of LIWC2015 Norms
Words per sentence	WPS	-	24.33	17.40 (not %)
Words longer than 6 letters	BigWords	-	13.14%	15.60
Linguistic Dimensions				
Personal Pronoun	ppron	I, them, her	16.89	9.95
1st personl singular	I	I, me, mine	8.91	4.92
1st person plural	We	We, us, our	2.10	0.72
2nd person singular	You	You, your, yours	2.52	
Adverbs	Adverb	Very,really	17.63%	5.27
Negations	Negate	No, not, never	5.95	1.66
Psychological Processes				
Affective Processes	Affect	Happy, cried	5.85	5.57
Positive Emotions	Emo_pos	Love, nice	6.89	3.67
Negative Emotions	Emo_neg	Hurt, Ugly	2.30	1.84
Anxiety	Emo_anx	Worried, fear	2.30	0.31
Anger	Emo_anger	Hate, kil	0.96	0.54
Sadness	Emo_sad	Crying, grief	3.20	0.41
Social Processes	Social	Mate, talk	6.38	9.74
Family	Family	Dad, aunt	0.84	0.44
Friends	Friend	Buddy, neighbour	5.63	0.36
Certainty	Certitude	Always, never	4.16	1.35
Past Focus	Focuspast	Ago, did, talked	6.30	4.64
Present Focus	Focuspresent	Today, is, now	13.14	9.96
Future Focus	Focusfuture	May, will, soon	1.68	1.42
Time	Time	End, until, season	8.91	5.46
Work	Work	Jobs, majors	3.97	2.56
Leisure	Leisure	Cook, chat, movie	3.75	1.35
Home	Home	Kitchen, landlord	2.52	0.55
Money	Money	Audit, cash, owe	1.93	0.68
Religion	Relig	Altar, church	1.69	0.28
Death	Death	Bury, coffin, kill	1.30	0.16
Swear words	Swear	Fuck, damn	0	0.21

5.3.2 GAD with LIWC categories

The Impact of BIS/BAS

Two hypotheses were formulated to answer the research questions. Hypothesis 1 assumed that compared with mentally stable students, Chinese university students suffering from GAD have different linguistic patterns in their writings. To validate this hypothesis, correlations were computed between overall GAD and each LIWC category, including words per sentence (WPS), words longer than six letters (Bigwords), personal pronoun (ppron), first personal singular (I), first personal plural (we), second personal plural (you), adverbs (Adverb), negations (Negate), affective processes (Affect), positive emotions (Emo_pos), negative emotions (Emo_neg), anxiety (Emo_anx), anger (Emo_anger), sadness (Emo_sad), social processes (Social), family (Family), friends (Friend), certainty (Certitude), past focus (Focuspast), present focus (Focuspresent), future focus (Focusfuture), time (Time), work (Work), leisure (Leisure), home (Home), money (Money), religion (Relig), death (Death), and swear words (Swear). As the third column in Figure 9 shows, positive relationships are identified between GAD and personal pronouns, negations, affective processes, negative emotions, anxiety, anger, sadness, and past focus, while negative relationships are identified between GAD, positive emotions, and present focus.

Hypothesis 2 predicted that the relationship of GAD and linguistic patterns of Chinese university students differs depending on their personality traits. The fourth to last column of Figure 9 display the correlation between BIS/BAS with LIWC categories in the case of no GAD or having GAD respectively. The results show that Chinese university students, high on BIS (but without GAD), tend to use fewer personal pronouns (r=-0.135, p<0.05), negations (r=-0.167, p<0.05), affective processes (r=-0.188, p<0.05) and past focus expressions (r=-0.164, p<0.05), while use more positive emotions (r=0.145, p<0.05), family-related words (r=0.16, p<0.05) friend-related words (r=0.145, p<0.01), certainty words (r=0.178, p<0.05) and are more present focused (r=0.255, p<0.01). In contrast, Chinese university students high on BIS and GAD use more negative emotions (r=0.112, p<0.05), anxious words (r=0.144, p<0.05), and past-focused verbs(r=0.107, p<0.5). As for BAS Sensitivity, when without GAD, Chinese university students like to use more positive emotions (r=0.196, p<0.05), family-related words (r=0.169, p<0.05) and leisure-related words (r=0.245, p<0.01) while Chinese university students with GAD use more negative emotions (r=0.176, p<0.5), and are more present focused (r=0.174, p<0.05).

Figure 9: The Impact of BIS/BAS When Screening for GAD

	Abbreviation	GAD	BIS-sensitivity		BAS-sensitivity	
			No GAD	GAD	No GAD	GAD
Words/sentence	WPS	-0.124	-0.12	0.121	0.096	-0.024
Words longer than 6 letters	BigWords	0.072	0.05	0.093	-0.051	-0.138
Linguistic Dimensions						
Personal Pronoun	ppron	.135*	-.219**	0.12	0.032	-0.107
1st personal singular	I	-0.086	-0.09	0.155	0.079	-0.061
1st person plural	We	0.095	0.015	-0.161	-0.116	0.073
2nd person singular	You	-0.077	-0.137	-0.133	-0.019	-0.021
Adverbs	Adverb	-0.12	-0.092	-0.059	0.105	-0.128
Negations	Negate	.22**	-.167*	0.003	-0.042	0.131
Psychological Processes						
Affective Processes	Affect	.35*	-.188*	0.093	0.152	-0.017
Positive Emotions	Emo_pos	-.134*	.145*	0.011	.196*	0.04
Negative Emotions	Emo_neg	.143*	0.15	.112*	0.027	.176*
Anxiety	Emo_anx	.172**	0.081	.144*	0.047	0.267
Anger	Emo_anger	.151**	0.068	0.055	0.008	0.147
Sadness	Emo_sad	.251**	0.045	0.091	0.101	-0.094
Social Processes	Social	-0.004	-.169*	0.065	-0.125	-0.044
Family	Family	-0.06	.16*	0.121	.169*	0.202
Friends	Friend	-0.024	.145**	0.110	-0.015	-0.004
Certainty	Certitude	-0.031	.178*	-0.128	-0.01	-0.182
Past Focus	Focuspast	.114*	-.164*	.107*	0.028	0.335
Present Focus	Focuspresent	-.184*	.255**	0.118	0.1	0.174*
Future Focus	Focusfuture	-0.079	-0.041	0.029	-0.079	0.259
Time	Time	0.174	0.109	0.145	0.167	0.269
Work	Work	0.088	0.093	-0.108	0.138	-0.155
Leisure	Leisure	-0.053	-0.006	0.245	.245**	0.185
Home	Home	-0.087	0.034	0.257	-0.017	0.073
Money	Money	0.055	-0.054	-0.209	0.131	-0.081
Religion	Relig	-0.023	-0.064	0	0.013	0
Death	Death	0.102	0	-0.032	0	-0.179
Swear words	Swear	0	0	0	0	0

The Impact of PANAS

The results of Figure 10 show that Chinese university students who are high on Positive Affect (PA) but without GAD tend to write more words longer than 6 letters (r=0.210, p<0.01), more words regarding social processes (r=0.193, p<0.05), present-focused verbs (r=0.202, p<0.05), future-focused verbs (r=0.168, p<0.05) while using fewer negations (r=-0.180, p<0.05), and certainty-related expressions (r=-0.214, p<0.01). When students are both high on PA and GAD, they use more personal pronouns (r=0.310, p<0.01) but fewer friend-related (r=-0.418, p<0.01) and home-related (r=-0.387, p<0.01) expressions. Among those students who are high on Negative Affect (NA) but without GAD, personal pronouns were less frequently used.

Figure 10: The Impact of PANAS When Screening for GAD

	Abbreviation	GAD	PA–sensitivity		NA–sensitivity	
			No GAD	GAD	No GAD	GAD
Words/sentence	WPS	-0.124	0.011	-0.023	-0.123	0.129
Words longer than 6 letters	BigWords	0.072	.210**	-0.210	0.096	-0.037
Linguistic Dimensions						
Personal Pronoun	ppron	.135*	−0.010	-.310**	-.252**	0.257
1st personal singular	I	-0.086	−0.102	-.288*	-.262**	.316*
1st person plural	We	0.095	0.127	0.132	0.026	-0.169
2nd person singular	You	0.083	0.083	0.138	0.040	-0.156
Adverbs	Adverb	−0.061	-0.061	0.171	-.156	0.120
Negations	Negate	−0.180*	-.180*	-0.057	-0.118	0.150
Psychological Processes						
Affective Processes	Affect	0.056	0.056	-0.094	0.019	-0.169
Positive Emotions	Emo_pos	0.065	0.065	0.120	-0.125	-0.041
Negative Emotions	Emo_neg	-0.107	-0.107	-0.253	0.050	-0.027
Anxiety	Emo_anx	-0.048	-0.048	-0.157	-0.033	-0.045
Anger	Emo_anger	-0.021	-0.021	-0.150	0.074	-0.050
Sadness	Emo_sad	-0.029	-0.029	-0.072	0.062	-0.066
Social Processes	Social	.193*	.193*	-0.161	0.006	-0.023
Family	Family	0.145	0.	-0.012	-0.024	0.056
Friends	Friend	0.004	0.004	-.418**	-0.036	0.155
Certainty	Certitude	-.241*	-.241**	0.207	0.087	-0.275
Past Focus	Focuspast	-0.043	-0.043	-0.033	-0.101	0.252
Present Focus	Focuspresent	-.202**	-.202**	-0.107	0.089	-0.158
Future Focus	Focusfuture	-.168*	-.168**	-0.029	0.002	-0.105
Time	Time	-0.101	-0.101	-0.154	-0.046	-0.188
Work	Work	-0.034	-0.034	-0.123	-0.052	-0.131
Leisure	Leisure	0.075	0.075	-0.194	-0.047	-0.111
Home	Home	-.066	-0.066	-.387**	-0.023	0.123
Money	Money	0.083	0.083	0.140	-0.031	-0.138
Religion	Relig	0.053	0.053	0	-0.051	0
Death	Death	0	0	0.055	0	0.003
Swear words	Swear	0	0	0	0	0

5.3.3 Depression with LIWC Categories

The impact of BIS/BAS

Hypothesis 1 also predicted a relationship between depression and linguistic patterns. By computing the correlation coefficients between the scores of the PHQ-8 and aforementioned LIWC categories, the results are shown in the third column of the Figure 11. There are positive relationships between depression and personal pronouns, negative emotions, sadness and past focus, and negative relationships between depression and positive emotions and present focus.

That the relationship of depression and linguistic pattern in Chinese university students differs depending on BIS/BAS was confirmed in Hypothesis 2 (see Figure 11). When high on BIS but without depression, Chinese university students would use more certainty words (r=0.166, p<0.05) and present focus expressions (r=0.226, p<0.01), but use fewer personal pronouns (r=-0.207, p<0.01), negations (r=-0.19, p<0.05), affective processes (r=-0.197, p<0.05), and social process words (r=-0.155, p<0.05). Chinese university students with both high BIS and depression tend to use more negative emotions (r=0.208, p<0.05), anxiety words (r=0.226, p<0.05), and past-focused verbs (r=0.139, p<0.05). For Chinese university students high on BAS, that don't suffer from depression, family-related words (r=0.187, p<0.05) and leisure-related words (r=0.252, p<0.05) more frequently emerged in their text, while negative emotions (r=0.128, p<0.05), friend-related expressions (r=-0.155, p<0.05) and certainty-related expressions (r=-0.132, p<0.05) were rarely mentioned. Chinese university students high on BAS and depression used more negative emotions (r=0.149, p<0.05), past focus expressions (r=0.362, p<0.01) and time-related words (r=0.411, p<0.01), but fewer leisure-related words (r=-0.356, p<0.01).

Figure 11: The Impact of BIS/BAS When Screening for Depression

	Abbreviation	Depression	BIS-sensitivity		BAS-sensitivity	
			No Depression	Depression	No Depression	Depression
Words/sentence	WPS	-0.015	-0.163	0.174	0.014	0.342
Words longer than 6 letters	BigWords	-0.049	0.045	0.127	-0.115	-0.033
Linguistic Dimensions						
Personal Pronoun	ppron	.126*	-.207**	0.058	0.005	0
1st personal singular	I	0.06	-0.083	0.123	0.035	0.08
1st person plural	We	-0.023	0.027	-0.199	-0.108	-0.077
2nd person singular	You	-0.051	0.164	-0.102	0.035	0.013
Adverbs	Adverb	-0.041	-0.121	0.033	0.113	-0.009
Negations	Negate	0.095	-.19*	0.038	-0.133	0.385
Psychological Processes						
Affective Processes	Affect	-0.052	-.197*	0.108	0.136	-0.027
Positive Emotions	Emo_pos	-.114*	0.108	-0.086	0.156	0.077
Negative Emotions	Emo_neg	.165**	0.137	.208*	-.128*	.149*
Anxiety	Emo_anx	0.021	0.065	.226*	0.067	0.176
Anger	Emo_anger	0.092	0.054	0.001	-0.004	-0.083
Sadness	Emo_sad	.177**	0.054	-0.064	0.096	-0.109
Social Processes	Social	-0.019	-.155*	-0.033	-0.13	-0.084
Family	Family	-0.03	-0.129	0.009	.187*	0.12
Friends	Friend	0.004	0.044	0.190	-.155*	0.097
Certainty	Certitude	0.02	.166*	-0.083	-.132*	-0.197
Past Focus	Focuspast	.134*	-0.134	.139*	0.013	.362**
Present Focus	Focuspresent	-.141*	.226**	0.233	0.058	0.355
Future Focus	Focusfuture	0.049	-0.077	0.058	-0.005	0.168
Time	Time	0.147	0.108	0.063	0.118	.411**
Work	Work	0.041	0.108	-0.146	0.076	-0.081
Leisure	Leisure	-0.021	0.007	0.062	.252**	-.356**
Home	Home	-0.012	0.006	0.295	-0.054	0.154
Money	Money	0.095	-0.042	-0.218	0.142	-0.069
Religion	Relig	-0.022	-0.065	0	0.005	0
Death	Death	0.109	0	-0.022	0	-0.154
Swear words	Swear	0	0	0	0	0

The Impact of PANAS

The correlations between PANAS and LIWC categories are shown in Figure 12 below. Specifically, Chinese university students who are high on PA but without depression like to use more words regarding social processes ($r= 0.175$, $p<0.05$) but use fewer certainty-related expressions ($r=-0.265$, $p<0.01$) and past-focused verbs ($r=-0.197$, $p<0.05$). Students who are both high on PA and depression tend to use fewer friend-related expressions ($r=-0.412$, $p<0.01$). Students high on NA but without depression use fewer personal pronouns ($r=-0.237$, $p<0.01$) and adverbs ($r=-0.178$, $p<0.05$), while those both high on NA and depression, use more negative emotions ($r=0.172$, $p<0.05$) but fewer positive emotions ($r=-0.135$, $p<0.05$) and leisure-related words ($r=-0.350$, $p<0.01$).

Figure 12: The Impact of PANAS When Screening for Depression

	Abbreviation	Depression	PA–sensitivity		NA–sensitivity	
			No Depression	Depression	No Depression	Depression
Words/sentence	WPS	-0.015	0.078	-0.111	-0.134	-0.155
Words longer than 6 letters	BigWords	-0.049	.188*	-0.136	0.117	-0.013
Linguistic Dimensions						
Personal Pronoun	ppron	.126*	0.009	-.311*	-.237**	0.065
1st personal singular	I	0.06	-0.065	-.353**	-.215**	0.040
1st person plural	We	-0.023	0.120	0.130	0.018	-0.005
2nd person singular	You	-0.051	0.077	0.259	-0.046	-0.067
Adverbs	Adverb	-0.041	-0.044	0.159	-.178*	-0.042
Negations	Negate	0.095	-0.127	-0.161	-0.118	-0.028
Psychological Processes						
Affective Processes	Affect	-0.052	0.011	-0.028	0.029	-0.012
Positive Emotions	Emo_pos	-.114*	0.030	0.158	-0.058	-0.135
Negative Emotions	Emo_neg	.165**	-0.120	-0.245	0.047	0.072
Anxiety	Emo_anx	0.021	-0.065	-0.128	-0.064	0.110
Anger	Emo_anger	0.092	-0.006	-0.169	0.083	-0.042
Sadness	Emo_sad	.177**	-0.077	-0046	0.054	0.087
Social Processes	Social	-0.019	.175*	-0.062	-0.004	-0.023
Family	Family	-0.03	0.123	-0.002	0.020	0.025
Friends	Friend	0.004	0012	-.412**	-0.033	0.099
Certainty	Certitude	0.02	-.265**	0.260	0.005	-0.025
Past Focus	Focuspast	.134*	-0.097	0.044	-0.078	0.242
Present Focus	Focuspresent	-.141*	-.172*	-0.167	0.062	-0.069
Future Focus	Focusfuture	0.049	-0.098	-0.110	-0.003	-0.256
Time	Time	0.147	-0.110	-0.142	0.005	-.309*
Work	Work	0.041	-0.065	0.021	0.006	-0.152
Leisure	Leisure	-0.021	0.107	-0.113	-0.010	-.360**
Home	Home	-0.012	-0.073	-0.184	-0.033	-0.010
Money	Money	0.095	0.078	0.132	-0.026	-0.086
Religion	Relig	-0.022	0.053	0	-0.052	0
Death	Death	0.109	0	0.049	0	0.010
Swear words	Swear	0	0	0	0	0

5.3.4 Comparison with previous work

ecause the present research is an extended study of Chiara Mazza's work (Mazza, 2020), which was conducted among Western university students, mainly Italian and Dutch. Therefore, by putting the results together one can find differences and similarities between Chinese university students and Western students.

From Figure 13, it can be seen that the percentage of Western university students having GAD (39.0%) is more than double than for Chinese university students with GAD. Nevertheless, an extra verification tool - PROMISE T-scores (Schalet et al., 2014) has confirmed the reliability of the data of Chinese students with or without GAD. The reason for this difference might be that for the things Chinese don't like, such as investigation of their mental conditions, they tend to perform in good but not real directions (Furnham & Chan, 2004).

Figure 13: Comparison of GAD percentage

	With GAD	Without GAD
Present Research	16.2%	83.8%
Previous Research	39.0%	61.0%

The Figure 14 shows the correlations of LIWC categories and GAD of the Dutch, and Italian sample, which was extracted from Chiara's study, and the Chinese sample from the present research. It can be observed that depending on the nationality, students affected by GAD tend to use different linguistic patterns. When being anxious, Dutch students use more social and death-related expressions, Italian and Chinese students use more negations, affective, anger-related, sad-related expressions, and fewer positive emotions. Italians and Chinese have much more in common, except for the usage of affective words, which are less used by Italians and frequently used by Chinese.

Figure 14: Comparison of correlations of LIWC categories and GAD

Variable	GAD Level		
	Dutch	**Italians**	**Chinese**
Negate	0.114	.426**	.22**
Affect	0.017	-.260*	.35*
Posemo	-0.184	-.397**	-.134*
Anger	0.159	.279*	.151**
Sad	0.104	.335*	.251**
Social	.423*	0.053	-0.004
Focus Future	-0.322	-.263*	-0.079
Death	.501**	0	0

6 Discussion

A survey was conducted among Chinese university students to explore the relationships between GAD, depression, personality traits and natural language. The contributions of this research, including the main findings, related to scientific relevance, practical relevance, the limitations of the current research, and the recommendations for future work, are as follows:

6.1 Scientific Relevance

This study shows that Chinese university students suffering from GAD tend to use more personal pronouns, negations, affective processes, negative emotions, anxiety expressions, anger expressions, sadness, past focus verbs. Also, they employ fewer positive emotions, and present focus verbs. These findings provide an answer to Sub-Research Question 1 that the written texts provided by Chinese university students can be used to differentiate between students with or without GAD. Moreover, these findings offer confirmation to the views of an already vast literature (Pennebaker et al., 2003; Lyons et al., 2018; Ramirez-Esparza et al., 2008) that negative emotion words more frequently emerge in the texts of people with anxiety or depression. Besides, this study identified positive relationships between GAD and affective emotions, including expressions of anxiety, anger and sadness. For those Chinese university students suffering from GAD, the linguistic analysis of their text indicated that they are more past-focused than present-focused. This confirms existing findings (Kong, 2019) that depressed people perceive a slower passage of time than normal people, and are dominated by the past over present and future.

According to the results of Figure 9, personal pronouns are important signals to differentiate Chinese university students with or without GAD. However, different from the viewpoints of previous research (Pennebaker et al., 2003; Givens, 2020) that higher frequency use of first personal pronouns reflect higher levels of anxiety, in this study the significant distinction between the first personal pronoun and the second personal pronoun was not shown. Pennebaker mentioned that pronouns are one kind of words that have implicated deception. Liars are more ‘non-immediate’ than truth-tellers and refer to themselves less often in their stories (Pennebaker et al., 2003). This may be an explanation that Chinese university students covering them up when filling in the questionnaires makes them liars, who rarely refer to themselves and use first personal pronouns less.

Sub-Research Question 2 stated that when screening of GAD, the written texts of Chinese university students would differ based on students’ personality traits. The results show that Chinese university students suffering from GAD, when they are high on BIS, use more negative emotions, anxious words, and past-focus expressions. When they are high on BAS, such students tend to use more negative emotions, and to be more present-focused. Chinese university students without GAD, but high on BIS uses fewer personal pronouns, negations, affective processes and past focus expressions, and more positive emotions, family-related words friend-related words, certainty words, while being more present focused. The group high on BAS likes to use more positive emotions, family-related words and leisure-related words. This finding is in line with previous studies ((Gray, 1981; Gray, 1982; Cohen et al., 2008) that BIS is linked to negative affect, high levels of anxiety and depression, and shows in more negative emotions in their natural speech.

A new linguistic finding in the present study is the correlation between BIS and past-focused verbs for Chinese university students without GAD. Such students use more past-focused verbs than those with low BIS. This is similar to a recent study in which depressed participants responding to the Zimbardo Time Perspective Inventory (ZTPI) were shown to be

more preoccupied with the past (Kong, 2019). For the BAS correlations with LIWC categories, when Chinese students are without GAD, the findings are in harmony with previous study: there are positive relationships between BAS, positive words, and positive effect (Cohen et al., 2008). Likewise, another new linguistic finding is the correlation between BAS and leisure-related expressions for Chinese university students suffering from GAD. When suffering from GAD, students who are high on BAS use more leisure-related expressions than those who are low on BAS. As Nimrod et al. (Nimrod et al., 2012) stated, high levels of depression lead to less involvement in leisure activities, which in turn increases the level of depression. Tonietto et al. (Tonietto et al., 2021) have similar views that those who think leisure is wasteful have lower levels of happiness and higher levels of depression, anxiety and stress.

As shown in Figure 10, the written texts provided by Chinese university students differentiate between students with or without depression, while their written texts also differ based on the students' personality traits. More specifically, students with depression used more personal pronouns, negative emotions, sadness-related expressions and past-focused verbs, while students without depression used more positive emotions and present-focused verbs. This is in line with previous study that negative emotions are more frequently used by depressed people (Ramirez-Esparza et al., 2008; Leis et al., 2019). Students with depression, when high on BIS, use more negative emotions, anxiety words, and past-focused verbs, while they are high on BAS, they tend to use more negative emotions, past focus expressions, time-related words, and fewer leisure-related words. Students without depression, when high on BIS, use certainty words and present focus expressions, but use personal pronouns, negations, affective processes, and social processes less frequently. When high on BAS, family-related words and leisure-related words are more frequently found in their text. Therefore, there are distinctions between the impact of BIS and BAS personality on written texts also for depression.

The general trend of the correlations between GAD-LIWC categories and depression-LIWC categories is consistent. Importantly, the trend of Chinese university students both high on BIS and GAD and Chinese university students both high on BIS and depression is the same. Negative emotions, anxious expressions, and past-focused verbs were all more used in their written texts. This finding is in harmony with previous studies (Ross et al., 2007; Hundt et al., 2008) that high BIS links to comorbidity of anxiety and depression. That is, when Chinese university students are high on BIS and GAD, the written texts provided would very likely to show that they have depression at the same time.

Finally, Figures 13 and 14 show the differences and similarities of the percentage of Chinese university students and Western students with and without GAD, and the correlations of LIWC categories and GAD compared to Chiara Mazza's research (Mazza, 2020). As for the lower percentage of Chinese university students reporting GAD, except for the reason that Chinese tend to perform good especially for the things they don't like (Furnham & Chan, 2004), the new six-dimensional frameworks for personality-the HEXACO model (Ashton & Lee, 2007) might explain it. Compared to the traditional five-factor model (FFM), honesty-humility is an important addition in the HEXACO model. Honesty suggests sincerity while humility suggests unpretentiousness. Therefore, the percentage of Chinese displays the disadvantages of the factor-honesty and humility in the HEXACO model.

6.2 Practical Relevance

First, the present study offers insight into the current mental conditions of Chinese university students beyond existing research (Ma et al., 2009), which could help both domestic and foreign psychologists to learn more about their mental conditions. A deeper understanding of the psychology of university students is beneficial for providing them with efficient consultation and treatment, which would have a positive impact on their future career prospects and social relationships (Aalto-Setälä et al., 2001). A mentally healthier younger generation would obviously be more helpful to Chinese university and society at large.

The finding that Chinese university students suffering from GAD or depression tend to use different linguistic patterns compared to mentally stable students depending on their personality could provide a more efficient service and treatment to patients. With analysis of simple texts or speeches, whether someone suffers from GAD/depression or not, can be diagnosed. Besides, previous study also confirmed that understanding patients' personality traits is more helpful to give them therapeutic treatment (Corr & Matthews, 2020). These insights may also be useful in the development of e-health applications. People may directly have conversations or consultations with e-health applications, which could give them efficient diagnosis and treatment that incorporates personality traits, instead of making an appointment with real psychologists. By doing so, more people would get timely consultation and treatment.

6.3 Limitations

We should hasten to acknowledge the limitations of this research. First of all, the participants of the experiment are all university students. Therefore, the findings from this study may not generalize to the wider population. Second, Chinese tend to show their good side to the outside world and cover up their true situations. Therefore, when investigated for mental disorders, Chinese university students would very likely fill in the answers that avoid being diagnosed with mental disorders. As previous studies indicated, Chinese have a higher stigma toward mental illnesses than Westerners, which would lead to more avoidance of these mental illnesses in Chinese university and society (Furnham & Chan, 2004). This problem may be the reason that the percentage of the students with GAD/depression in this experiment is lower than the figures of the previous studies (Rook, Mazza, Lefter, & Brazier, 2022). Finally, the survey was completely conducted online, as a result of which the place and circumstances of the participants could not be monitored. It was for example not possible to check whether the participants filled in the questionnaires with serious mind or to check whether they described their true conditions.

6.4 Future Work

The research of exploring the relationships of GAD, depression, personality traits and natural language especially among Chinese university students is still in its infancy. Thus, some recommendations are made for future work. First of all, to apply to normal people and wider population, the sample size should be improved. For example, people of all ages, ethnic minorities, and of all backgrounds should be incorporated into the survey. Besides, since Chinese tend to fill in answers that are not true to themselves, confirmatory questions should be included in surveys to prevent conflicting answers. It is better to shuffle the question order of questionnaires to let Chinese participants drop their guard and make them forget that the survey is to investigate their mental conditions.

The temporal aspect is an important finding in the present study. To confirm and extend this finding, it may be possible to incorporate the Zimbardo Time Perspective Inventory (ZTPI) in future study. The ZTPI is a widely used questionnaire to

measure dimensions of time, such as past, present and future (Zimbardo et al., 1999). Therefore, not only the writing task but also this questionnaire may test the perception of participants. To generalize this finding to the wider population, in future work, participants of other countries should be incorporated into the survey.

7 Conclusion

Nowadays, mental illnesses are universal around the globe. However, compared with developed countries, the health budget assigned to mental health is much lower in low-income or developing countries (Mnookin et al., 2016). Even in China, a country with a large population, the epidemiological data on mental health (anxiety and depression) are too few to have sufficient understanding. Despite the current research that is to identify GAD and Depression from natural language, and seeks to explore the relationships of personality and GAD and Depression has until now not conducted in Chinese language. Besides, university students are a very noteworthy students, who are going through the transition from adolescence to adulthood, and facing a lot of challenges in this process. Therefore, this research explored the relationships of Generalized Anxiety Disorders, Depression, Natural Language and Personality Traits among Chinese university students. Through an experiment, an online survey included GAD-7, PHQ-8, BIS/BAS, and PANAS questionnaires, and a writing task, the hypotheses proposed have all be accepted:

Figure 15: Hypothesis Results

N	Hypothesis	Final Results
H1	Chinese university students suffering from GAD or Depression have different linguisitc patterns compared to thoses mentally stable.	Accepted
H2	Chinese university students with or without GAD or depression have different linguistic patterns based on their personality traits.	Accepted

Several Research Questions and Sub-Research Questions were answered through the experiment. The written texts provided by Chinese university students differentiated between students high or low on GAD and depression, and these texts differ based on students' personality traits. In general, the Chinese university students' linguistic patterns, therefore, reflect whether they have GAD and Depression or not, and also reflect their personality traits.

Besides, a new linguistic finding in this research is the correlation between BIS and past-focused verbs. Chinese university students high on BIS use more past-focused verbs than those low on BIS. To confirm and extent this finding, the Zimbardo Time Perspective Inventory (ZIPI) should be incorporated in the future study to double test the time perception of participants with the writing task.

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