Research article

Depression and disclosure behavior via social media: A study of university students in China

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ABSTRACT

Severe stress and depression constitute serious challenges to people in both personal and public health. Numerous university students suffer from depression each year while only fractions of them receive proper and competent treatments. Following the trends of the era, social media has been prevalent among university students and become a new platform to disclose depression references. The purpose of this study is to examine the effects of various stressors and the "Big Five" personality traits towards the intention of disclosing depression. Addition to the disclosure intention, this study also explores if respondents have presented their depression via social media profiles. Over 200 WeChat users were surveyed on their experiences from psychological stress factors under four categories - academy, relationship and practical issues.

1. Introduction

In the recent decade, depression has been a severe health concern around the world. According to the World Health Organization in 2018, more than 300 million people were estimated to suffer from depression, which equivalent to 4.4% of the global population. In fact, nearly half of them live in the South-East Asia Region and Western Pacific Region, indicating the relatively larger populations in these two regions (for example, which include China and India) (World Health Organization, 2018). Around 85.67 million people with depression come from South-East Asia Region, which accounts for around 27% of the total cases of depressive disorders. Prevalence rates of depression vary by age, it was reported by World Health Organization that the majority occurred in older adulthood (over 7.5% are females aged 55–74 years and over 5.5% are males). Nevertheless, depressed young adults are also significant. Around 4.5% of females aged 15–19 years and about 6% of females aged 20–24 years suffer from depressive disorders, and the figures for males of these two age groups are around 3% and 4% respectively (World Health Organization, 2018).

During the years of adolescent and young adult, depression often shows its onset and is associated with the health and social concerns negatively (Ewing et al., 2015). Despite the prevalence of depression, university students suffered from depression are often undiagnosed, as many of them do not seek for clinical services or perceive the needs for help (Moreno et al., 2011). Under this situation, many students do not

have any proper way to solve their depressive disorders and are unaware of their needs for help, which may contribute to tragedies that could have been avoided. As reported by Centers for Disease Control and Prevention in 2015, depression can lead to suicide, and it is found that suicide has been a major contributor to death among college-aged students in recent years.

This study intends to reveal university students with depressive disorders. Besides examining the influences via personality and stress towards depression, this study also tries to reveal the relationship between depression and sufferers' intention to disclose the depression. Though past researches examined that disclosing depressive emotions could help releasing stresses and depression. It was found that depressive sufferers might not be willing to disclose their actual feelings to others. Garrison et al. (2012) identified that individuals with high depressive symptoms and those with insecure attachment orientations were supposed to limit their use of emotional disclosure as a method to regulate emotion.

Although past researches have focused on the effects that disclosing one's emotion could release stresses and depression, very few covered the relationship between the intention of disclosing depression and the depression disclosure via social media. In the digital era, social media has been recognized as a strong "lens" that could expose people's psychological states (De Choudhury et al., 2017) and people who preferred different social media may have different level of self-disclosure (Shane-Simpson et al., 2018). In this regard, this study attempts to explore the feasibility of predicting depressive disorders via social media and to fill

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the gap of missing information between the relationships of depression and social media.

In China, WeChat has more than 500 million monthly active users and becomes the most popular online communication application and leading social networks. In the first quarter of 2018, there were nearly 1,040 million active users use WeChat on a monthly basis. WeChat Moments is a social-networking function that allows users to share and get access to WeChat friends' information, photos and profile status. More than 60 percent of WeChat users adapt WeChat Moments to share their experience and feelings. Therefore, it is appropriate to investigate depression disclosure behavior through this popular social media platform.

As digital footprints are useful to understanding people (Yaakov et al., 2019), this study will evaluate the texts, emotions and pictures posted on "moments" as these messages may indicate either positive or negative emotions. Feelings of guilt, sadness, helplessness and worthlessness shown on posts may characterize depression (De Choudhury et al., 2013). Respondents' expression that were posed in the past two weeks were examined via Moments because we argued that stress could come from study, relationship with friends and classmates, and their future prospects. These emotions usually last for a while and hence, it is reasonable to capture two weeks' postings to understand their disclosure behavior.

As aforementioned, this study will examine the influences of personality traits and various stressors towards university students' depression, the depression's influences on disclosure intention and the effects of intention to disclose depression towards the disclosure behavior via social media. With that, our research questions include: What is the influence of various stress factors on depression? Would people with certain personality characteristics be more likely to suffer from depression? How is disclosure intention related to the disclosure behavior via social media? From the literature, past researches have focused more on the causes and effects of depression and the emotional disclosure, while the relationship between the intention of depression disclosure and the behavior that discloses depression on social media is unclear. This study will assess the onsets of depression of netizens especially the young adults like university students and intend to address that stated research questions above.

2. Literature review

In general, depression can affect people of all ages throughout one's life, the likelihood of having depression could be because of genes, physical illness, life events and problems caused by alcohol and drug abused (World Health Organization, 2018). According to Penninx et al. (2008), both depressive and anxiety disorders are highly heritable, with the heritability rate estimated to be between 35-40%. Under this circumstance, the prediction, identification and support for depression sufferers are highly in need for study.

Stress is one of the major factors leading to depressive disorders. In a physiological perspective, stress is one of the potent factors that could suppress adult neurogenesis, probably result from the increased release of glucocorticoid (Jacobs et al., 2000). Based on the symptoms of clinical depression, Jacobs et al. (2000) demonstrated that stress can induce the decreases in dentate gyrus neurogenesis, which is an important causal factor in the precipitation episodes of depression.

Not only does the genetic cause of the early stage in human life make an influence on the occurrence of depression, but also sufferers' actions towards depression. For example, avoidant behavior could affect the development of depressive disorders. Originated by Lynn (1981), behavioral theories of depression focus on the role of maladaptive moves act in both the onset and the maintenance of depression. Later researches posited that certain changes in the environment coupled with the avoidant behaviors would inhibit sufferers from experiencing the environmental reward and reinforcement, which would then lead to depressive disorders (Carvalho and Hopko, 2011).

Literature also indicated that major life stress, especially those experienced with social rejection and interpersonal loss, would be an essential risk factor for developing depressive disorders. It is well known that psychosocial stress is one of the most powerful predictors of adolescent depression (Lolak et al., 2014). Especially for the undergraduates who are facing unique upheaval, they could spend much more time with peers rather than with their own families. In this case, they exert numerous energies forming and expanding peer networks, and when peer rejection occurs, it can become a particular source of psychosocial stress that would lead to the adolescent depression of the young adults (Platt et al., 2013).

Some previous studies have estimated the prevalence of depression of university students in some Asian regions such as mainland China, and have identified some underlying factors of sociology-demographic aspects associated with depression in this population. According to Chen et al. (2013), year of study, satisfaction in school performance, situation of family income and parental relationship were found greatly associated with depression of the undergraduates. Undergraduate students who were older, less satisfied with their school performance, with lower family income or poor parental relationships were easy to develop depression.

3. Theoretical Framework

Conservation of Resources (COR) Theory describes the motivation that drives people both to maintain their current resources and to pursue new resources (Hobfoll, 1989). Some research on COR examined how the loss of resources impacted the level of one's stress (Hobfoll, 2001), and one's mood that resulted in burnout (Neveu, 2007). Overall, COR model helps indicating the relationship between stress and depression. In addition, some other researchers also suggested that personality traits could affect depression (Zhang et al., 2015). As such, we included Big Five in this study to evaluate its impact on depression. Disclosure on social media is considered as a help-seeking behavior for social support from others. People suffer from different levels of depression may have different intention to seek support through their connections in social network.

In summary, we attempt to leverage the theory of conservation of resources and personality traits to study depression and emotional disclosure and their relationships in a social networking site. Our framework model consists of personality and psychological stress which influence depression. In addition, depressed people tend to disclose more information on social media. Figure 1 highlights the theoretical model of all hypotheses.

4. Hypotheses

4.1. Psychological stress and depression

Stress refers to a feeling of strain and pressure in daily life. It has direct relationship with low mood and negative emotion. Individuals with high stress are more likely to have negative emotions, such as anger, nervousness and fear. According to COR, psychological stress occurred in three instances where there was a threat of loss of resources, an actual loss of resources and a lack of gained resources following the spending of resources (Hobfoll, 1989). The result of loss of resources leads to physical and emotional exhaustion and people are likely to suffer from depression.

Moreover, Cohen (2000) argued that anxiety, depression, anger and alienation are emotions accompany with stress. Depression is a kind of mood disorder which causes low mood and affects people's feelings and sense of well-being. Some researchers found that one of the main sources of depression was life stress, such as daily hassles (Kanner et al., 1981). Stress will increase risk of developing depression if people cannot deal with it well. Therefore, a significant relationship between stress and depression is expected to be found:

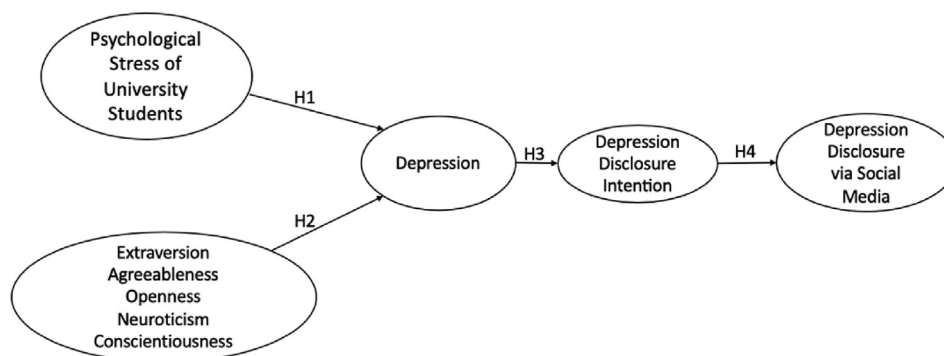**H1.** Stress has a positive relationship with depression.

Figure 1. Theoretical framework.

4.2. Personality and depression

Personality refers to the traits among individuals which influences people's cognitions, emotions, motivations and behaviors in different situations. It is associated with emotional experience and emotional expression. Klein, Kotov and Bufferd (2011) suggested that personality played an important role in different stages of depressive conditions.

Some study stated that five-factor model (FFM or Big Five) provided a valid and reliable assessment for measuring individual's personality (Digman, 1990). The five factors are extraversion, agreeableness, openness to experience, neuroticism and conscientiousness. Since these five factors can capture differences in personality effectively, the "Big Five" model is the most widely used model in measurement of individual personality (Soto et al., 2016) and has been translated to many different languages (John and Srivastava, 1999).

Generally, extraverts are sociable, talkative and draw energy from interacting with other, while introverts get tired of interacting with others and avoid communicating with others. Extraverts tend to take advantage of any opportunities for social interaction. These people are comfortable with others, love to meet new people and have good conversations. As a result, they have high demand of self-presentation (Seidman, 2013) and social needs, which is opposite to depression symptoms. Hence, we have the following hypothesis:

H2a. Extraversion has a negative relationship with depression.

Agreeable people are friendly, altruistic and helpful and avoid the pursuit of selfish pleasures (Roccas et al., 2002). Others can easily get along with agreeable people since they concern about others' feelings and likely to harvest friendship. Zhang and Ling (2015) found agreeable people are used to like and give positive comments to others' posts in social media. Hence, they have good relationships people around them and are likely to keep away from depression. We expect that:

H2b. Agreeableness has a negative relationship with depression.

People who are open to experience are often willing to try new things. They are sensitive to their own feeling, creative and curious. These individuals love to share their new and novel experiences with others. Besides, openness is expected to be positively related to metal healthy from a humanistic perspective (Rogers, 1961), so we expect that people with higher openness are less likely to be depressed.

H2c. Open to experience has a negative relationship with depression.

Neuroticism is the tendency of individuals to experience psychological stress. People who score high on neuroticism are likely to have unpleasant emotions, such as fear, anger, anxiety and depression. Neurotic people feel isolated and lonely easily, so they are highly likely to develop anxiety and depression disorders (Zinbarg et al., 2016). Therefore, we hypothesize as following:

H2d. Neuroticism has a positive relationship with depression.

Conscientious people are thoughtful, considerate and self-disciplined. Individuals with high conscientiousness demand high-quality

relationships with others. Amichai-Hamburger and Vinitzky (2010) found that they had a larger number of friends than those with lower conscientiousness level. Hence, people with high conscientiousness may have protection against anxiety and depression. Moreover, some researchers suggested low conscientiousness was associated with depressed mood (Hakulinen et al., 2015). Hence, we expect:

H2e. Conscientiousness has a negative relationship with depression.

4.3. Depression and disclosure intention

Kahn and Garrison (2009) found that the symptoms of depression were associated with self-disclosure. Disclosure intention refers to people's tendency to express themselves and show their emotions. Conservation of Resource theory states that people tend to invest their resources in order to protect against and recover from resources loss (Halbesleben et al., 2014). People suffering from depression may find some coping strategies to release their depressive symptoms, such as communicating with others and telling their negative emotions to their family and friends. Some researchers found that college students are more likely to disclose through social media and express their emotions, such as Facebook (Moreno et al., 2011) and other social media like WeChat Moments as well. Hence, we have the following hypothesis:

H3. Individuals with higher level of depression are more likely to disclose themselves.

4.4. Disclosure intention and disclosure via social media

Disclosure behavior is a process that people reveals his/her information, including feelings, thoughts, successes, failures and one's likes and dislikes, to another people on WeChat Moments. Ajzen and Fishbein, 1980 showed that intention was a subjective probability used to measure whether people would perform a behavior. People who have high intention to disclose themselves are more likely to express their feelings on social media. Therefore, disclosure behavior via social media shows a closely relationship with one's intention to disclosure.

H4. Disclosure intention has a positive relationship with disclosure behavior via social media post.

4.5. Control variables

People with different ages may vary on their disclosure behaviors (Christofides et al., 2012) and females have a higher tendency to disclose themselves, compared with males (Valkenburg et al., 2011). Besides, undergraduates from different grades may have different level of stress and differentiated intention to disclose. Therefore, we included age, gender, year of study and WeChat Moments usage as control variables in this research. The coding for age is 1 for "below 18", 2 for "18 to 19", 3 for "20 to 21", 4 for "22 to 23" and 5 for "above 24". In terms of gender, 1

for "male" and 2 for "female". WeChat moment usage or frequency of post be indicated by 1 for "less than once a month", 2 for "once a month", 3 for "2 to 3 times a month", 4 for "once a week", 5 for "2 to 3 times a week", 6 for "once a day", 7 for "more than once a day".

5. Methodology

5.1. Measurements

In the questionnaire, respondents were prompted with questions measuring different scales in our comprehensive model. According to Stallman and Hurst (2016), factors of university students' stress were academic, equity, relationships, parenting, practical and health based on University Stress Scale (USS). Some researchers argued that undergraduates' stress was from personal hassle, academic hassle and negative life events (Li et al., 2005). In order to make the questions fit reality for Chinese undergraduates and modify the University Student Scale, a focus group interview was conducted to identify the source of stress that would affect undergraduates' emotion. The focus group interview was comprised of a university professor who has experience teaching undergraduate courses and 5 students who were attending a bachelor program in a university in China. The group was presented with a set of questions as shown in Figure 2.

Based on the results of focus group interview, we incorporated and modified the above two scales: USS from Stallman and Hurst (2016) and that from Li et al. (2015). We categorized the stress questions into 3 groups: stress from study, social relationship problems, future prospect problems. Respondents were asked to rate on 7-point Likert-type scale ranging from 1 "no stress at all" to 7 "extreme stress". From Li et al. (2005), we have items related to "examination pressures", to measure the stress from academic hassle. From USS as introduced by Stallman and Hurst (2016), we adopted items like "difficulties in maintaining romantic relationships" and "future work".

Besides stress, we measured personality traits "Big Five" using the twenty questions from the Mini-IPIP Scales (Donnellan et al., 2006). Four items for each trait. 7-point Likert-type scale ranging from 1 "strongly disagree" to 7 "strongly agree" are applied to these twenty items. For example, extraversion is ascertained by the questions such as "I am the life of the party", "I sympathize with others' feelings" is used to measure agreeableness, conscientiousness is measured by questions like "I get chores done right away", neuroticism is assessed by "I have frequent mood swings" and "I have a vivid imagination" measures openness to experience. Based on reliability testing and on the increase of Cronback's alpha values, one item from extraversion and one item from agreeableness were removed from the analysis.

In this research, Beck Depression Inventory II (BDI-II) was adopted to access the depression symptom of the respondents. BDI-II, was published in 1996 to address the current situation in the modern society, was a modified version of BDI, which was proposed by Beck, Ward, Menedelson, Mock and Erbaugh in 1961 to measure the severity of depressed symptoms. With high validity and reliability across cultures, BDI has been translated into many languages (Lee et al., 2017). The respondents were prompted to answer 12 items out of the original 21 items from the Beck Depression Inventory (BDI-II). Some items referring to suicide, weight, health, appetite, etc. were omitted, as we considered they were not relevant to the university students in China. To answer the 12 questions, respondents were required to recall their feeling and emotions over the past 2 weeks. A higher score indicated higher level of depression. We adopted a 7-point Likert-type scale from 1 = "strongly disagree" to 7 = "strongly agree" in these items.

Furthermore, the Distress Disclosure Index (DDI) by Kahn and Hessling (2001) is an efficient and valid scale to measure individual's intention of disclosing distressing emotions and thoughts. DDI has been used widely on studies of help-seeking attitudes and behaviors (Kahn et al., 2012) to identify people's intention of express their emotion. To investigate respondents' disclosure intention, 6 items from DDI (without reverse items) were used to evaluate their intention of disclosing themselves without reverse questions based on a 7-point Likert scale. For instance, one of the items is "When I feel upset, I usually confide in my friends" and the scale is ranging from 1 = strongly disagree to 7 = strongly agree.

In addition, we collected respondents' emotional expression posts on WeChat Moments within the previous two weeks. In order to identify the emotional expression posts relevant to the depressed emotions, we analyzed the term frequency among respondents. These emotional expression posts with emotional indication were collected and checked for emotional disclosure.

Sentiment lexicons are lists of words with associations to positive, neutral and negative sentiments. According to Zhang and Chen (2016), the Chinese Vocabulary for Sentiment Analysis (VSA) released by HowNet is a comprehensive set of Chinese lexicon. We counted the number of negative and positive posts on Moments according to VSA in this study. The lexicon includes 836 positive terms and 1254 negative terms related to expression of sentiment. Some examples in VSA are listed in Table 1. Disclosure behavior via Moments is measured based on the lexicon and we count objectively the total number of negative and positive Moments posts as the following variables: a) negative posts via text, emoticon and picture, b) positive posts via text, emoticon and picture. If a depressed emotion was disclosed through text message, the corresponding variable (negative posts through text) would be recorded as "1" respectively; otherwise, it would be recorded as "0". If a Moments post showed positive emotion, the corresponding positive variable would be coded as "1".

6. Data collection

To identify and select the target respondents, we selected the undergraduates from random universities located in China. We approached the potential respondents randomly and added them as friends on WeChat so we could send them a link of the questionnaire link through

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Introduction
1. Please introduce yourself. (Name)
2. What is your major/research field?
Exploration
3. What are the essential factors that will make you/students feel stressful?
4. Among those proposed factors raised in question 3, which is the most important one?
5. Which is the second most important factor?
6. Which factor is a must that it cannot be ignored?
Ending question
7. Additional sharing and comment among interviewees.

Figure 2. Questions for focus group interview.

Table 1. Some examples from VSA.

Positive examples		Negative examples	
Like	喜欢	No	不
good	好	Bad	不好
say	说	Boring	无聊
thank	谢谢	no way	不行
joyful	开心	disgusting	讨厌
fun	好玩	die	死
lovely	可爱	abuse	骂人
good-looking	好看	angry	生气
pretty	漂亮	rubbish	垃圾
clever	聪明	sad	伤心
delicious	好吃	useless	没用
songful	好听	trouble	麻烦
best	最好	idiot	傻

WeChat. Respondents were also encouraged to invite their friends to engage in the survey.

Our survey was conducted from 15th October 2018 to 15th December 2018. The data collection was conducted in three separate times. All respondents were expected to fill in two questionnaires: one was used to assess psychological stress and personal characteristics; the second questionnaire was to evaluate depressed emotion and disclosure intention.

A total of 203 frequent college users of Moments had participated in the research. These University students were interested in the study because the research subject was closely related to their personal experience and that they were curious about the related findings. Table 2 shows descriptive statistics of respondents' profiles.

In regards to the ethics issues related to this research, we have sought approval from the human subject ethics committee in the Hong Kong Polytechnic University for this study. This ensured our data collection procedure were complied with the ethical standard and the respondents' personal details were kept in confidential throughout the process.

In this regard, our research assistants firstly informed participants the details about this research (i.e., their sharing of information in the past two weeks via WeChat Moments would be monitored). We explained the confidentiality of the data we collected and the collected data was only used for this specific research. Participants knew the data we collected would not be disclosed to others and all agreed upon the related arrangement.

For the participants who agreed to take part in this study and authorized us to access their posts on Moments, our research assistants would send a friend request on WeChat. When the respondents accepted and became the WeChat friend, the questionnaire link was sent to them so they got access to the content of emotional expression on their Moments for the data collection. One week after the respondents finished the first questionnaire, the same respondents would receive the second questionnaire. In parallel, we observed and collected their positive and negative emotion disclosure via Moments, such as posting emoticon showing sadness and text message indicating negative emotion.

Table 2. Descriptive statistics of respondents.

Gender: Male (71, 34.98%), Female (132, 65.02%)

Age: Below 18 (8); 18–19 (52); 20–21 (107); 22–23 (31); 24 or above (5)

Year of Study: Year 1 (25, 12.32%); Year 2 (36, 17.73%); Year 3 (43, 21.18%); Year 4 (99, 48.77%)

Frequency of Post: Less than once a month (28, 13.79%); Once a month (31, 15.27%); 2–3 times a month (51, 25.12%); Once a week (18, 7.39%); 2–3 times a week (45, 22.17%); Once a day (21, 10.34%); More than once a day (9)

Average Number of Posts: 3.43 (Negative); 12.86 (Positive)

In order to differentiate self-related and self-unrelated posts when deciding about their negative or positive content, our research assistant reviewed and studied through the two weeks' posts of each respondent. It is because a social media post can be evoked technically by anything, it can relate to a wide range of topics, life events or happenings of the world, so self-related posts should be identified and be used for analyses. In other words, we only limited the posts related to perceived stress, emotions and feelings from the respondents.

7. Analyses and findings

To proceed our analysis, means, standard deviations and bivariate correlations for all variables were firstly examined. Next, we ran with linear regressions to test all the hypotheses as this method could resolve the problem of multicollinearity, outliers, heteroscedasticity and polynomial relationships (Hair et al., 1998; Neter et al., 1990). The results are shown in the corresponding tables attached in the appendixes. To assure the data is normally distributed, the multivariate normality was examined and was confirmed that the data was distributed fairly.

Reliability indicates the specific extent to which a construct does not have errors and keeps showing the characters of "consistency" or "repeatability" (Cortina, 1993). In this research, Cronbach's alpha was applied to examine the consistency of the internal scales with multiple items (Kline, 2000; George and Mallery, 2003; DeVellis, 2012). Based on the findings, all the alpha values were above 0.8, which indicated that there was good consistency internally. Moreover, as all the measures used for the constructs were utilized in previous studies, with all questions in the questionnaire were validated by scholars and applied to various fields of behavioral, social and psychological science, the content validity of the items within this study was considered acceptable.

Apart from the reliability of the measurements, convergent validity is another factor being used to evaluate the measurement scales, indicating that to which degree the two measures of constructs that are theoretically related distinguishable (Anastasi and Urbina, 1997). The convergent validity are evaluated by factor loadings. There are two criteria used normally, that all the indicator factors loadings should be exceed 0.50 (Bagozzi and Yi, 1988) to be considered significant, and the average variance extracted (AVE) for each construct should be greater than the variance made by the measurement errors (i.e., should exceed 0.5) (Fornell & Larker, 1981). The factor loadings of the 53 items were exhibited in Table 3, where all items except for the second item of the relationship construct (with a value of 0.593) and for the second item of the BDI-II (with a value of 0.533) owned a value exceed 0.6 on their corresponding constructs. Therefore, the convergence of items on various intended constructs was vastly fulfilled. In addition, the AVEs of the constructs were in fact greater than the variances because of measurement errors. Thus, in this case, both the criteria for convergent validity were achieved.

To justify the discriminant validity, correlation matrix of the data set was displayed in Table 4, which helped verifying all the possible overlapped constructs. The discriminant validity of the construct was tested by comparing the AVE of a construct and its squared inter-correlation with others (Anastasi and Urbina, 1997). In between, if the AVE is larger than the squared inter-correlation, the construct's discriminant validity is guaranteed. Table 4 demonstrated that the elements on the diagonal line (showing the squared root of the variance of two constructs) were all higher than the inter-correlations, meaning that the discriminant validity of all the constructs were confirmed.

In addition to the validity of measurement, the standard deviations of all items were measured as well because we supposed the sample generated enough variations to represent the whole population. As shown in Table 5, the means of the items indicated that the survey participants tended to have stress from academic performance (mean = 4.557), academic workload (mean = 4.394) and practical issues (mean = 4.695) when compared to pressure from relationship (mean = 3.221). Besides, the results also showed that there was a moderate level of

Table 3. Factor analysis.

	1	2	3	4	5	6	7	8	9	10	11
ACD1	.258	.216	.174	**.613**	-.142	.007	-.012	.027	.385	-.001	.085
ACD2	.374	.284	.059	**.645**	.012	-.033	-.220	.040	.005	-.075	.131
ACD3	.239	.107	.175	**.653**	-.132	.161	-.020	.109	.278	-.105	.187
ACD5	.153	.051	.128	**.753**	-.038	-.065	-.209	-.122	.118	.024	.079
ACD6	.310	.171	.114	**.682**	-.004	-.109	.011	-.050	.242	.028	.062
ACD7	.250	.169	.168	.240	.004	-.158	-.044	-.105	.082	-.041	**.798**
ACD8	.219	.250	.193	.293	-.003	-.104	-.125	-.088	.130	-.025	**.711**
REL1	.332	**.688**	-.026	.228	-.185	-.035	-.080	-.109	-.019	-.041	-.002
REL2	.365	**.593**	.140	.182	-.163	-.103	-.242	-.205	.013	.057	.138
REL3	.385	**.648**	.124	.250	-.122	-.164	-.181	-.238	.015	.023	.043
REL4	.246	**.769**	.086	.078	-.160	-.036	-.067	-.120	.161	-.024	.173
REL5	.274	**.814**	.055	.155	-.059	-.018	-.114	-.050	.100	-.095	.112
REL6	.318	**.767**	.199	.076	-.151	-.062	-.103	-.023	.116	.065	-.002
REL7	.315	**.794**	.176	.062	-.125	-.089	-.170	-.068	.121	.044	.094
PRA1	.202	.128	.095	.310	-.091	.155	-.099	.062	**.660**	-.159	-.118
PRA2	.263	.100	.104	.218	-.118	-.002	-.092	.061	**.797**	-.053	.140
PRA3	.263	.130	.084	.232	-.114	-.055	-.127	.008	**.787**	-.084	.136
EXT1	-.069	.213	-.045	.029	-.070	.034	.052	.001	-.104	**.831**	-.011
EXT2	-.234	-.185	.015	-.087	.258	.219	.101	.176	-.021	**.747**	-.022
EXT3	-.158	-.085	.037	-.034	.192	.105	.065	.118	-.088	**.812**	-.030
AGR2	-.221	-.175	.008	.047	.251	.153	.266	**.742**	-.021	.060	-.102
AGR3	-.246	-.224	-.056	-.014	.261	.259	.223	**.687**	.051	.089	-.099
AGR4	-.140	-.093	-.002	-.045	.157	.093	.200	**.808**	.131	.142	-.014
CON1	-.215	-.096	-.064	-.002	.125	.192	**.672**	.363	-.171	.028	.029
CON2	-.185	-.176	-.121	-.120	.193	.165	**.763**	.183	-.057	.095	-.043
CON3	-.198	-.272	-.125	-.078	.301	.218	**.639**	.252	-.081	.027	-.063
CON4	-.148	-.239	-.143	-.179	.200	.174	**.727**	.107	-.105	.143	-.103
NEU1	-.011	-.067	-.054	.069	.158	**.785**	-.031	.148	.091	.083	-.173
NEU2	.008	.006	-.024	-.050	-.052	**.811**	.182	.174	-.157	.089	-.097
NEU3	.066	-.132	-.046	-.078	.115	**.825**	.215	.051	.082	.025	-.021
NEU4	.186	-.061	-.130	-.022	.197	**.800**	.138	-.018	.050	.112	.093
OPE1	-.229	-.221	-.072	-.065	**.679**	.209	.149	.325	-.075	.137	-.017
OPE2	-.267	-.198	-.048	.028	**.800**	.080	.239	.078	-.116	.111	-.026
OPE3	-.247	-.179	-.106	-.165	**.732**	.146	.204	.165	-.188	.009	-.036
OPE4	-.271	-.184	-.063	-.107	**.727**	.163	.143	.238	-.027	.179	.062
DE1	**.634**	.279	.121	.215	-.134	.201	-.041	-.287	.125	-.020	.087
DE2	**.533**	.210	.141	.211	.012	.175	-.099	-.330	.311	-.079	.170
DE3	**.732**	.217	.178	.122	-.110	.073	-.094	-.098	.183	-.076	.157
DE4	**.668**	.274	.177	.151	-.235	.060	-.019	-.046	.188	.023	.153
DE7	**.798**	.073	-.010	.150	.007	.064	-.082	-.152	.208	.005	.004
DE8	**.798**	.127	.077	.139	-.076	.010	-.077	-.229	.028	-.043	.021
DE11	**.657**	.283	.130	.064	-.237	.130	-.263	-.049	.029	-.080	.187
DE12	**.678**	.263	.088	.221	-.291	-.140	-.125	.050	.107	-.139	.062
DE13	**.612**	.266	.142	.243	-.292	-.018	-.057	-.047	.103	.002	-.020
DE14	**.713**	.235	.013	.201	-.154	-.082	-.172	-.087	.113	-.134	-.030
DE15	**.715**	.314	.080	.101	-.131	-.015	-.027	-.078	-.034	-.148	.117
DE16	**.707**	.214	.074	.115	-.055	.022	-.127	.056	.145	-.184	.063
DI1	.211	.189	**.796**	-.004	-.055	-.075	-.112	-.101	.033	.117	.056
DI3	.149	.092	**.861**	.085	.067	-.085	-.020	-.031	.083	-.005	.023
DI6	.144	.056	**.844**	.073	-.026	-.047	-.064	.040	.106	-.092	.082
DI7	.066	.044	**.878**	.124	-.046	-.042	-.008	.034	.108	-.004	.084
DI11	.011	.010	**.850**	.068	-.041	-.008	-.014	-.008	.009	-.017	.045
DI12	.017	.171	**.699**	.304	-.248	.001	-.226	-.059	-.075	.000	.026

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. The bold figures are highlighted to show the factor weighting greater than 0.5.
Rotation converged in 8 iterations.
ACD - academic factor; REL - relationship factor; PRA - practical issue; EXT - extravert; AGR - agreeableness; CON - conscientiousness; NEU - neuroticism; OPE - openness to experience; DE - depression; DI - disclosure intention.

depression among students (mean = 3.750) and that students had higher intention to disclose themselves (mean = 4.615).

Additionally, Harmon one-factor analysis was also conducted in this study to examine whether there would be any common method bias (Podsakoff et al., 2003). The results for the total variance obtained from the exploratory factor analysis of the essential variables indicated that no single factor, with a dominant value of 21.513%, accounts for most of the covariance. Therefore, we confirmed the preliminary evidence that the measurement model was robust to common method variance. All the information mentioned above suggested that there was not a common method bias in this research.

Multicollinearity is a state of very high intercorrelations among the predictor variables. The data with such a disturbance may not give a valid result about any individual predictor and statistical inferences may not be reliable. Some researchers suggested using the variance inflation factor (VIF) to detect multicollinearity. According to O'Brien (2007), a VIF of 5 or 10 and above indicated a multicollinearity problem. In this study, test for multicollinearity (as shown in Table 4) revealed that a very low level of multicollinearity was presented (VIF = 2.2496 for academic performance, 1.7237 for academic workload, 2.2712 for relationship factor and 1.8245 for practical factor). As such, it was reliable to use this set of data in the regression analysis.

To capture disclosure behavior using the two weeks' posts from the respondents, two research assistants were employed to code the posts. Following the recommendations of Shrout and Fleiss (1979), inter-annotator reliability was assessed by the average absolute agreement of the intra-class correlation coefficient (ICC) in a two-way random-mixed model (McGraw and Wong, 1996). The ICCs for the coding of the 1685 posts, which were generated by 203 respondents during their past two weeks since they answered the questionnaires. by the two coders on text, emoticon and picture were found to be 0.585 (95% confidence interval, CI: .429, .659), 0.683 (95% CI: .551, .725), and 0.522 (95% CI, .411, .608) respectively. Fleiss (1986) considered the level of agreement as fair to good when the ICC was between 0.40 and 0.75.

With the results of the regression analysis shown in Table 6, the R^2 of depression for model one with only control variables, model two and three with main effects were 0.093, 0.615 and 0.712 respectively.

Based on the results shown in Table 6, there were insightful findings that stress factors were significant factors in predicting depression. From the first-order effects displayed in model two, stresses from academic issue, relationship issue and practical issues had positive associations with depression and thus hypothesis H1 was supported. The R^2, being 0.615, was increased by 0.522, which was a great difference from the

variance could be explained by the control variables only. This demonstrated that the stress factors were the dominant factors to explain depression when compared to the control variables. In model 3, stress from academic issues majoring in academic consequences ($\beta = 0.313$, $p < 0.001$) and ones from relationships ($\beta = 0.260$, $p < 0.001$) and practical issues ($\beta = 0.142$, $p < 0.05$) would be more likely to lead to depression, while pressure from academic issues focusing on normal workload would have no significant contribution to depression.

In terms of Big Five, people who were of less extraversion ($\beta = -0.185$, $p < 0.001$) or less openness ($\beta = -0.174$, $p < 0.001$) or less agreeableness ($\beta = -0.158$, $p < 0.05$) were more likely to have depression, while people who were more neuroticism could have larger possibility to be depressed ($\beta = 0.275$, $p < 0.001$) and thus hypothesizes H2a, H2b, H2c and H2d were supported. However, we found that people who were conscientiousness had not showed any significant effects on causing depression, which rejected hypothesis H2e.

For the regression analysis on disclosure intention, results from model 2 of Table 7 showed that depression significantly led to disclosure intention ($\beta = 0.290$, $p < 0.001$). Regarding the effects brought by disclosure intention on actual disclosure via various means in WeChat based on the two weeks' posts, Table 8 indicated that they were positively related to each other for disclosure intention and actual disclosure behavior, which was counted by the numbers of negative posts shared by the participants. People who were inclined to disclosure intention were more likely to expose themselves by negative emoticons, texts and pictures posted, with $\beta = 0.051$, $p < 0.05$.

Along the line, we further investigated the relationship between disclosure intention and actual disclosure behavior via Moments if the disclosure behavior was measured by the ratio of negative emotional posts to total posts (sum of negative posts and positive posts). The result showed that there was a marginal significant relationship between disclosure intention and people's actual behavior with $\beta = 0.035$, $p < 0.10$. As such, this provided another predictor for measuring negative disclosure behavior.

7.1. Post hoc analysis

After we have verified the theoretical model, we explored further if there was any other interesting relationships from the data. Along with the suggestions from Allen et al. (2018), the relationship of perceived stress and depression could be moderated by personality. Based on this perspective, we uncovered that the relationship between academic performance and depression was negatively moderated by extravert ($\beta = -0.024$, $p < 0.05$), agreeableness ($\beta = -0.037$, $p < 0.01$) and openness

Table 4. Correlations.

	AVE	1	2	3	4	5	6	7	8	9	10	11
ACD1	0.417	.646										
ACD2	0.571	.565**	.755									
REL	0.531	.546**	.485**	.729								
PRA	0.563	.604**	.361**	.383**	.751							
EXT	0.637	-.183**	-.167*	-.164*	-.248**	.798						
AGR	0.559	-.189**	-.294**	-.446**	-0.0883	.315**	.747					
CON	0.493	-.374**	-.340**	-.538**	-.339**	.304**	.608**	.702				
NEU	0.649	-0.0738	-.222**	-.192**	0.0008	.247**	.346**	.403**	.805			
OPE	0.541	-.362**	-.261**	-.541**	-.348**	.373**	.570**	.609**	.326**	.736		
DE	0.477	.641**	.485**	.698**	.527**	-.318**	-.438**	-.486**	-0.0062	-.560**	.699	
DI	0.679	.382**	.355**	.327**	.253**	-0.0585	-.139*	-.300**	-.148*	-.245**	.320**	.824

ACD1 - academic performance; ACD2 - academic workload; REL - relationship factor; PRA - practical issue; EXT - extravert; AGR - agreeableness; CON - conscientiousness; NEU - neuroticism; OPE - openness to experience; DE - depression; DI - disclosure intention.

The elements on the diagonal line report the squared root of the variance of two constructs.

  ** Correlation is significant at the 0.01 level (2-tailed).

  * Correlation is significant at the 0.05 level (2-tailed).

Table 5. - Descriptive statistics and reliability.

Variables	Mean	S.D.
Academic performance (Cronbach's alpha0.876)	**4.557**	**1.2414**
Dissatisfactory grade	4.867	1.6066
Difficulty in discussing academic problems	4.355	1.6775
Examination pressure	4.901	1.4488
Low learning efficiency	4.527	1.6268
Poor academic ranking	4.473	1.5166
Academic workload (Cronbach's alpha 0.838)	**4.394**	**1.5057**
Too much homework in certain subjects	4.438	1.6501
Too many tests	4.350	1.5954
Relationship (Cronbach's alpha 0.904)	**3.221**	**1.7487**
Adjustment problems with roommates	3.276	1.8861
Disharmonious relationship between students and teacher	3.123	1.9875
Adjustment with students from other provinces	3.233	1.8452
Poor family relationship	3.202	2.0952
Difficulties in maintaining friendships	3.335	1.9412
Difficulties in maintaining romantic relationships	3.211	2.1607
Relationship breakdown	3.167	2.2142
Practical (Cronbach's alpha 0.862)	**4.695**	**1.4192**
Uncertainty after leaving a university	4.419	1.5276
Worry about the future career (e.g. employment)	4.911	1.6143
Lack of sufficient career guidance	4.754	1.6645
Extravert (Cronbach's alpha 0.809)	**3.328**	**1.2567**
I am the life of the party.	3.177	1.4719
I talk a lot.	3.414	1.4913
I talk to a lot of different people at parties.	3.394	1.4700
Agreeableness (Cronbach's alpha 0.886)	**4.223**	**1.4211**
I am interested in other people's problems.	4.148	1.5504
I feel others' emotions.	4.394	1.6627
I am really interested in others.	4.128	1.5069
Conscientiousness (Cronbach's alpha 0.891)	**3.831**	**1.5722**
I get chores done right away.	3.635	1.6931
I always remember to put things back in their proper place.	3.773	1.8503
I like order.	4.084	2.0094
I never make a mess of things.	3.833	1.6744
Neuroticism (Cronbach's alpha 0.867)	**3.611**	**1.4227**
I have frequent mood swings.	3.616	1.7435
I am not relaxed most of the time.	3.626	1.7084
I get upset easily.	3.867	1.6819
I often feel blue.	3.335	1.5908
Openness (Cronbach's alpha 0.913)	**4.216**	**1.5091**
I have a vivid imagination.	4.192	1.7737
I am interested in abstract ideas.	4.325	1.6267
I have no difficulty understanding abstract ideas.	4.054	1.7355
I have a good imagination.	4.291	1.6348
Depression (Cronbach's alpha 0.947)	**3.750**	**1.4697**
I feel sad.	3.650	1.7093
I feel discouraged about the future.	3.872	1.6867
I feel like a failure.	3.798	1.7445
I don't enjoy things the way I used to.	3.798	1.8705
I am disappointed in myself.	3.675	1.6389
I feel I am worse than everybody else.	3.828	1.8628
I am more annoyed and irritated than usual.	3.557	1.8643
I have lost my interest in other people.	3.906	1.9438
I have greater difficulty making decisions than I used to.	3.532	1.9147
I am worried that I am looking old or unattractive.	3.650	1.9297
I can't work as well as before.	3.798	2.0474
I don't sleep as well as I used to.	3.941	1.9208
Disclosure Intension (Cronbach's alpha 0.922)	**4.615**	**1.4187**

Table 5 (*continued*)

Variables	Mean	S.D.
When I feel upset, I usually confide in my friends.	4.837	1.6070
When unpleasant things happen, I often talk to someone.	4.749	1.5830
I try to find people to talk with about my problems.	4.680	1.6413
When I am in a bad mood, I talk about it with my friends.	4.813	1.6663
I seek out someone to talk to when I am in a bad mood.	4.567	1.6972
I am willing to tell others my distressing thoughts.	4.044	1.8247

to experience (β = -0.045, p < 0.001). The impact of relationship factor on depression was negatively moderated by agreeableness (β = -0.054, p < 0.001), and openness to experience (β = -0.053, p < 0.001), but positively moderated by neuroticism (β = 0.043, p < 0.01). The relationship between practical factor and depression was negatively moderated by agreeableness (β = -0.024, p < 0.05) and openness to experience (β = -0.043, p < 0.001). This was in line with Bouchard's (2003) findings that people with higher level of openness would adapt problem-focused coping mechanism better to handle their issues and were less depressed.

8. Implication to theories and practices

This study advances knowledge of depression and disclosure behavior in both theoretical and practical aspects. From the theoretical perspective, it focuses more on the area of depression caused by psychological stress and personality, the relationship between depression and depression disclosure intention, and the association of disclosure intention and the actual disclosure behavior. Align with the study of Roccas et al. (2002), this study also supports personality traits could make influences on depression. It is logic that people who are of less extraversion, less openness or less agreeableness would be more likely to suffer depression while people who are with more neuroticism tend to be more susceptible to get depressed.

From the practical perspective, this study confirms there are association of depression disclosure intention and the actual disclosure behavior, which indicates that people with higher disclosure intention would have more possibility to disclose their negative emotions via social media. Though past researches may have focused more on the causes and effects of depression and the emotional disclosure, while the relationship between the intention of depression disclosure and the behavior that discloses depression on social media is still unclear. In this study, the relationships among these topics are examined, for example, undergraduates who get depression would have higher tendency to disclose themselves. The findings and methods used in this study would be a useful reference for future studies.

8.1. Limitations

Several limitations should be considered in this study. First, data collection was limited to one single social media platform, the WeChat Moments. Although WeChat Moments is a very popular social networking platform in China, our results may restrict the universality to other social media platforms. Further research may collect data from multiple different platforms and alleviate the constraints. Second, our findings may be restricted by stress factors that only apply to university students. Further study may develop a more comprehensive model, including more stress factors on people in general. Third, the problem of common method bias may exist because the data was collected from self-reported surveys (Podsakoff et al., 2003) and through only one method (Straub et al., 1995). Although the common method bias did not have a significant influence on our results, further research may consider using multiple methods and longitudinal research designs.

Table 6. Regression analyses on depression.

	Model 1 *Control Variable*	Model 2 *Psychological Stress*	Model 3 *Big Five*
Control Variables			
Age	.302*	.050	.020
Gender	-.095*	-.032	-.037
Year of Study	-.188**	-.038	-.051
Frequency of Post	.162*	.066	.090*
Psychological Stress			
Academic performance		.320***	.313***
Academic workload		.045	.070
Relationship		.367***	.260***
Practical		.210***	.142*
Big Five			
Extravert			-.185***
Agreeableness			-.158*
Conscientiousness			-.003
Neuroticism			.275***
Openness to experience			-.174***
Model Information			
R^2	0.093	0.615	.712
ΔR^2		0.522	0.097

9. Conclusion

Knowing that there are so many undergraduates suffering from depression, this study has verified and examined the underlying factors and relationships affecting depression and actual disclosure behaviors. To sum up, with all analysis carried out by this study, stress factors such as academic, relationship and practical issues had positive associations with depression. In addition, people who are of less extraversion, openness or agreeableness would be more likely to suffer from depression, while people of more neuroticism could have larger possibility to get depressed. Furthermore, depressed people are supposed to be more likely to disclose their depression. For disclosure intention and actual disclosure behavior via social media, they were positively related to each other, meaning people with high intention to disclose themselves show more emotional expression on social media. From the follow up analysis, moderation effect of personality on the relationship between stress and depression were also explored. In reality, university students tend to be more proactive and have more understanding about their classmates' emotional disclosure. It would be ideal and encouraging that the health care agencies to find new way capturing negative emotional posts from social media to detect those people with depression for proper treatment timely.

Table 7. Regression analyses on disclosure intention.

	Model 1 *Control variable*	Model 2 *Depression*
Control Variables		
Age	-.028	-.115
Gender	-.021	.007
Year of Study	.010	.065
Frequency of Post	.172**	.125
Main Effects		
Depression		.290***
Model Information		
R^2	.038	.127
ΔR^2		0.089

Table 8. Regression analyses on disclosure behavior.

	Model 1 *Control Variable*	Model 2 *Disclosure Intension*
Control Variables		
Age	.021	.018
Gender	.001	.001
Year of Study	.008	.007
Frequency of Post	.025	.021
Main Effects		
Disclosure Intention		.051*
Model Information		
R^2	.035	.123
ΔR^2		0.088

Declarations

Author contribution statement

V. Cho: Conceived and designed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

M. Zou, M. Li: Performed the experiments; Wrote the paper.

Competing interest statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

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