

Course Paper for Academic Writing in English

Assessment of Undergraduates' Stress Level Based on Multi-Contributors Mining

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Abstract

Over the past few years, China youth research institution has reported that the proportion of undergraduates in China who suffered from stress accounted for 76.0% totally. This worrying trend could be observed in many universities. Therefore, we aimed to evaluate the level of mental stress in undergraduates and analyse factors that contribute to it. Multi-scale assessments were adopted including a number of multi-choice questions. Through principal component analysis, we selected a series of discriminative contributors. For these screened contributors, we evaluated their impacts by calculating their information entropy and used the weighted score of the questionnaire as participant's stress level. The stress level was divided into 5 ranks from good to extremely stressed, which made up 12%, 24%, 37%, 21%, 6% in percentage respectively. Further, we found that the top three contributors to mental stress were academic performance, social connections and financial conditions. These findings could help mitigate the problem of excessive stress in undergraduates.

Introduction

According to a study conducted by American Psychological Association (American Psychological Association, 2009), seven of ten United States adults claimed that they tolerated the problem of stress on a daily basis. While stress seemed to be an inevitable part of life, this problem of overstress was becoming more and more serious in undergraduates (Gallagher, 2008; Mackenzie et al., 2011). In addition to stress itself, overstressed undergraduates were more likely to suffer negative effects including poor academic performance (Misra, McKean, 2000), strained social relationship (Bayram et al, 2008), etc. Studies have shown that academic stress posed a serious threat to students, especially for undergraduates. Although moderate stress intensity could help maintain a reasonable sense of tension thereby improving studying efficiency, excessive academic pressure could trigger chains of problems (Anna Zajacova et al, 2005).

The issue of stress among undergraduates has raised attention in scientific research. However, few researchers focused on quantitative evaluation of the level of stress. Without a precise evaluation method, we could not rationally realize how serious the issue was.

In terms of contributors to mental stress, some scholars have completed valuable work. For example, good performance in high school might lead to mental stress in undergraduates (Maxine Gallander Wintre, 2011). Relationship between sleep quality and mental health has been built in a linear regression model, indicating poor sleep quality might cause stress (Hannah G. Lund, B.A, 2010). Other studies showed that students' inactive attitude towards extra-curriculum activities might lead to chronic stress (Blanca Elizabeth, Pozos Radillo, 2014).

To our knowledge, this paper was one of the first studies that weighed the contributors by a novel stress-evaluation method and ranked these contributors by their impacts.

Specifically, we focused on the stress in undergraduates. We designed a questionnaire and participants made choices according to their real situations. Each question reflected one possible contributor related to stress. Because the questions were set manually, some questions might not be discriminative enough in stress analysis. Hence, we selected questions by principal component analysis (PCA) and ignored uncorrelated questions. Because different contributors had different levels of influence on mental stress, it was unreasonable to directly take the total score of the questionnaire as the stress level of participants. Inspired by the fact that the less entropy meant the more information provided by the contributor, we proposed a cost-efficient method to weigh the contributors and evaluate the stress level.

We supposed that academic pressure might largely contribute to mental stress since many undergraduates attached great importance to academic performance. Social connections might be influential on the stress level since many undergraduates were sensitive to their relationships in their post-adolescence.

In this paper, we made the following contributions

- We investigated the stress status of college students and proposed a novel stress-evaluation method with a designated questionnaire, which contained various possible contributors related to stress.
- We analysed the contributors to mental stress and ranked them. In order to highlight the most influential contributors and improve accuracy, we filter some unnecessary questions and statistically illogical answers.
- We gave some suggestions aimed to mitigate the problems of mental stress in undergraduates.

Methods

Participants

We received 400 question-completed questionnaires totally. Participants consisted of 232 males and 168 females aged from 18 to 22 who were studying in University of Electronic Science and Technology of China.

We assumed that students would exhibit increasing levels of stress in the periods around midterm and final examinations, so we purposefully avoided collecting data during those periods in order to reduce the possibility of getting unreasonable results.

Stimuli (or Questionnaire)

Prior to completing the survey, participants were informed that all experimental data were for scientific research only. On the top of questionnaire, we inquired participants some basic information, including age, gender, major, grade and college.

Each questionnaire consisted of 20 choice questions. Options of questions were set on a 5-point Likert scale ranged from 0 to 4. The score of each choice question indicated the significance of each stressor, where 0 point meant “not significant at all” and 4 points meant “extremely significant”. Therefore, the full mark of a questionnaire was 80. The mark reflected the degree of stress on participants. Higher mark meant more factors were negatively affecting the stress level. The completed questionnaire was available in section Appendix.

Procedure

We randomly spread the questionnaires in the university where were densely populated, including dining hall, library, teaching building and dormitories. We tried our best to ensure that the number of participants in different genders and ages was equal. After collecting sufficient completed questionnaires, valid questionnaires were selected based on whether all questions were answered.

Data analysis

Suppose we were given m questionnaire examples $V = \{v_1, v_2, \dots, v_m\} \in \mathbb{R}^{n \times m}$, where v_i denotes i -th score vector computed by scores on i -th participant. Each element in v_i is the score i -th participant got on corresponding choice question, thereby 20 choice questions meant $v_i \in \mathbb{R}^{20 \times 1}$. In our case, $n=20$, $m=400$ and $V \in \mathbb{R}^{20 \times 400}$. Because the questions were set manually, some questions might be inappropriate if they had little correlation with stress. Alternatively speaking, data on some questions might not provide discriminative information about stress. In order to mitigate this problem, we applied principal component analysis (PCA) on V to help us ignore unnecessary questions. The detailed mathematical theory was available on (Andrew Ng, 2009). First, we normalized V by column and computed the covariance matrix Σ

$$\Sigma = \frac{1}{m} \sum_{i=1}^m v_i (v_i)^T$$

The eigenvector group of Σ and corresponding eigenvalue were denoted as $U = \{u_1, u_2, \dots, u_n\}$ and $\lambda = \{\lambda_1, \lambda_2, \dots, \lambda_n\}$ respectively. Mathematically speaking, u_i reflected the direction in n -dimensional space where data $\{v_1, v_2, \dots, v_m\}$ had the i -th largest variance. Therefore, the questions with large eigenvalue meant that they provided discriminative information about stress. By comparing the distribution of λ , we removed unnecessary questions while ensuring the summation of the rest eigenvalue over 90% of the original eigenvalue summation, which meant little information loss after question selection.

We considered that different factors exerted different impacts on stress. Therefore, it was not reasonable to calculate the sum of score on all questions as one’s stress mark. By entropy-weight method (EWM), we computed weight of each question by the comentropy the question provided. The less comentropy meant the higher provided information, thereby meaning higher weight. The detailed process could be found on (Cheng Qi-yue,2010). The comentropy and weight were calculated as follow,

$$e_j = -\frac{1}{\ln(n)} \sum_{j=1}^n y_{ij} \ln y_{ij}$$

$$w_j = \frac{1 - e_j}{\sum_i 1 - e_j}$$

where $y_{ij} = \frac{V_{ij}}{\sum_{j=1}^n V_{ij}}$ meant normalized score on i-th question, j-th participant.

So far, we have selected informative questions and calculated their weights. By sorting the weight of each question (contributor), we could discover the most influential contributors to undergraduates’ mental stress. Then we computed the weighed summation of score on all participants and divided the scores into 5 parts, indicating the stress level ranged from good to extremely stressed.

Results

Questions Selection

We applied principal component analysis (PCA) to compute the distribution of eigenvalue λ . The detailed results were shown on Table 1 and Figure 1, where Index of Question were abbreviated to I.Q because of space constraints.

| | | | | | | | | | | |
|------------|------|------|------|------|------|------|------|------|------|------|
| I.Q | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| eigenvalue | 0.32 | 0.52 | 0.25 | 0.44 | 0.01 | 0.31 | 0.43 | 0.39 | 0.25 | 0.42 |
| I.Q | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| eigenvalue | 0.57 | 0.03 | 0.61 | 0.32 | 0.06 | 0.77 | 0.69 | 0.51 | 0.04 | 0.19 |

Table 1: the distribution of eigenvalue λ in all questions

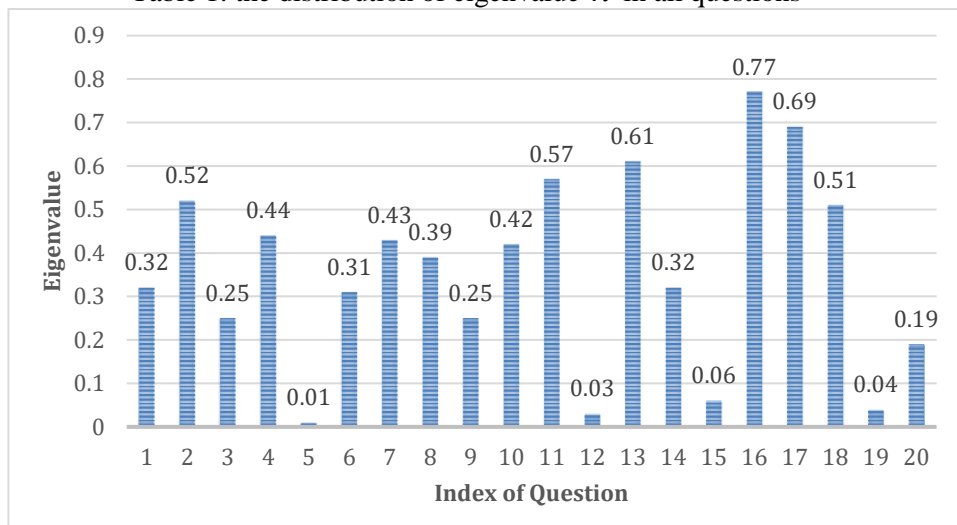


Figure 1: the distribution of eigenvalue λ in all questions

As shown in Figure1, questions {5,12,15,19} had relatively small eigenvalue, which meant scores on these questions showed low variance, thereby providing little discriminative information. The questions we removed were listed as follow,

Question 5: “Do you have good self-learning skills?”

Question 12: “Do you often tremble unconsciously?”

Question 15: “Can you bear to be disturbed when doing something important?”

Question 19: “Is it difficult for you to slow down your pace of life?”

The ratio of the rest eigenvalue summation and the original eigenvalue summation was $1 - \frac{\lambda_{\{5, 12, 15, 19\}}}{\lambda_{\{all\}}} = 0.98 > 0.90$. It indicated that there was little information loss after question selection.

Contributors Analysis

The questionnaire set $V \in R_{16 \times 400}$ was applied by EWM to compute the weight of each contributor. The experimental result was shown on Table 2 and Figure 2, where Index of Question were abbreviated to I.Q because of space constraints.

| | | | | | | | | |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|
| I.Q | 1 | 2 | 3 | 4 | 6 | 7 | 8 | 9 |
| Weight | 0.061 | 0.034 | 0.078 | 0.023 | 0.098 | 0.09 | 0.052 | 0.042 |
| I.Q | 10 | 11 | 13 | 14 | 16 | 17 | 18 | 20 |
| Weight | 0.082 | 0.094 | 0.072 | 0.056 | 0.038 | 0.066 | 0.073 | 0.041 |

Table 2: the weight of screened questions (contributors)

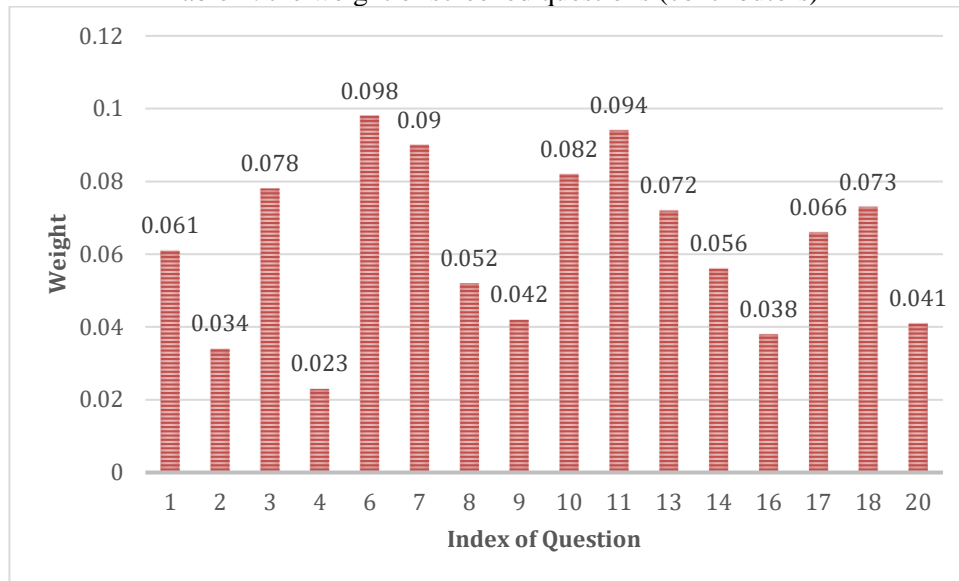


Figure 2: the weight of screened questions (contributors)

As shown in Figure 2, we found the weights distributed unevenly, which meant different contributors had different impacts on mental stress. If we just simply summed the score of each question as one’s level of stress, the result must be inaccurate.

By ranking the weight, we found questions {6,11,7} had the three highest weights. Therefore, the corresponding contributors had the greatest influence on mental stress. The questions were listed as follow,

Question 6: “Are you feeling stressed to pursue your ideal academic performance?”

Question 11: “Is your mood often influenced by social connections?”

Question 7: “Do you worry about your financial condition?”

The top three influential contributors were academic performance, social connections and financial condition respectively. Besides, questions {10,3,18,13} had relatively high

weights (>0.070), the corresponding contributors were physical condition (satisfying/unsatisfying), accommodation (living in-campus/off-campus), enrolment type (exchange students/non-exchange students) and grade (lowerclassmen /upperclassmen).

Stress Assessment

By computing the weighted summation of mark on each participant, we could evaluate the level of stress. In order to make general sense, we focus on the overall distribution of the stress level rather than personal conditions. We averaged five levels according to the scores of stresses from good to extremely state. Alternatively speaking, six critical scores among five levels were 0.0, 12.8, 25.6, 38.4, 51.2, 64.0 since the full mark of a questionnaire was $4*(20-4) = 64$. The detailed classification was shown in Table 3 and the distribution of the level of stress was shown in Figure 3.

| Level of Stress | Good | Ordinary | A Little Stressed | Stressed | Extremely Stressed |
|-----------------|----------|-----------|-------------------|-----------|--------------------|
| Mark | 0.0~12.8 | 12.8~25.6 | 25.6~38.4 | 38.4~51.2 | 51.2~64.0 |

Table 3: The classification of the level of stress

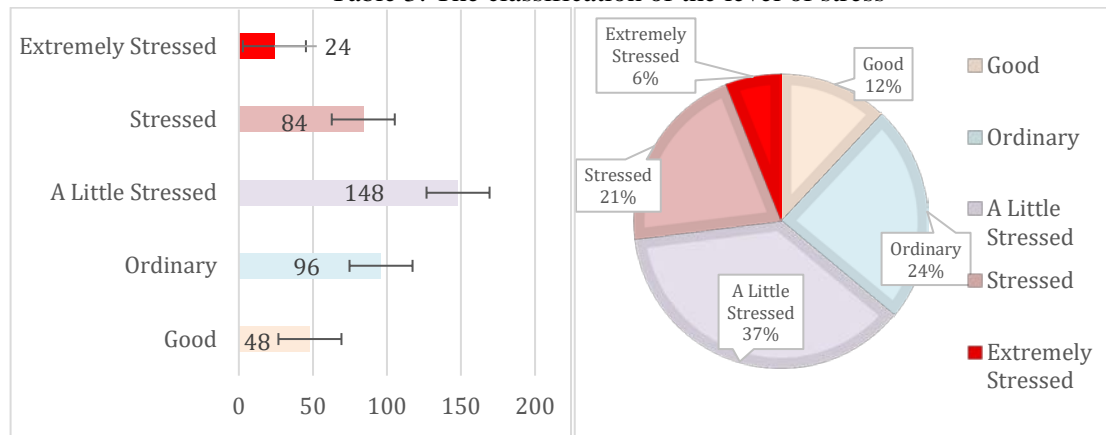


Figure 3: The distribution of the level of stress in all valid participants

As it was shown in Table 3, we denoted different levels of stress as ‘Good’, ‘Ordinary’, ‘A little Stressed’, ‘Stressed’ and ‘Extremely Stressed’. From Figure 3, we found that the proportion of undergraduates in five levels of stress was 12%, 24%, 37%, 21% and 6% respectively. The distribution of the level of mental stress showed unimodality. Most of undergraduates (37%, 140/400) felt a little stressed. However, the figure for undergraduates who thought that they maintained a good state of mind was merely 12%. We found 64% of undergraduates believed that they felt at least a little stressed in their daily lives.

Discussion

One of our goals of this research was to mine possible contributors of stress in undergraduates. As shown in figure 2, some of the screened contributors had relatively high weight which meant high influence. The top 7 influential contributors were academic performance, social connections, financial condition, physical condition, accommodation, enrolment type and grade respectively.

To some extent, the top three concerns listed above directly related to undergraduates’ lives. For example, the main goal of most of undergraduates was to become educated, find a well-paid job after graduation. It was understandable that students attached great importance to their academic performance, which could help them achieve their goals. Additionally, high-quality social connections allowed college students to have more opportunities for

satisfying jobs. Therefore, it was not surprising that undergraduates would become stressed if they had no promising academic performance or social contacts.

Regarding financial conditions, the high level of concern was mostly likely a result of more than simply the financial cost of access to college. For many students, university was the first time that they were living away from home and were responsible for the cost of everyday living expenses, such as food, clothing and rent. The great stress that financial concerns placed on undergraduates indicated that independent living forced them to make a reasonable budget and develop financial responsibility.

Physical condition was also an effective contributor about stress. It indicated universities need to pay attention to personal well-being. Previous research conducted on undergraduates identified similar contributors to the results noted above, including sleep quality (Orzech, 2011), body image dissatisfaction (Kostanski, 1998), etc.

Our results also indicated that those students living off-campus suffered higher stress level than students living in-campus. This result concurred with previous research which showed that students who lived off-campus were more likely to face problems about mental health (Lester, 2013; Othieno, 2014). We speculated this outcome resulted from the fact that those students who live off-campus had extra problems like paying rent each month, planning and preparing meals and addressing any problems that may happen in their apartment or house.

In addition, our results showed that exchange students were more stressed than non-exchange students. While moving to a new studying environment might be interesting for exchange students, they were likely to face difficulties such as inadaptation in courses and local food. Further, exchange students might not integrate into local students' social circles because of linguistic differences and cultural differences.

Lastly, upperclassmen were more stressed compared with freshmen and sophomores. While most universities had programs to help freshmen adapt to college life, results indicated that some official assistance could be necessary for upperclassmen to accomplish courses in their senior years and hopefully reduce their stress. Previous research had also demonstrated an increase of stress in senior students (Naushad, 2014; Mahmoud, 2012). However, researcher (Bayram, 2008) conducted a study about undergraduates in Turkey and reported that freshmen and sophomores had the highest stress level. Further research need to be done to explained this discrepancy.

Conclusion

In this study, we utilized the data feature in questionnaires and successfully screened out contributors to mental stress in undergraduates. We ranked contributors by their influence. The top three contributors were academic performance, social connections, financial condition respectively. Physical condition, accommodation, enrolment type and grade were also influential to undergraduates' state of mind. Furthermore, we evaluated stress level in undergraduates according to the distribution of questionnaires mark. Generally speaking, stress level in undergraduates showed unimodality.

Future Work

From a management perspective, it could be beneficial for universities to adjust regulations based on our found above. Because of the increasing trend of severe mental symptoms in college students (Eisenberg, 2010), universities should consider analysing their students' mental health on a regular basis. Therefore, a further implication of this study, is to guide universities to implement a systematic and continuous method to evaluate students'

mental health. With the development of technology, we believe this kind of evaluation will be technically available.

Limitations

The limitations of this experiment were listed below.

- The definition of “social connections” was not clearly stated, thereby participants might suffer semantic ambiguity when they were filling out questionnaires. For example, some undergraduates might consider their relationship with classmates as “social connections”, while others might treat the socialization with working adults as “social connections”.
- The sample size of questionnaires might not sufficient enough to rule out the possibility of accidental results, despite data processing.

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Appendix

Table 1 *Questionnaire used in our experiment*

Before you fill out the questionnaire, we promise you that this questionnaire does not involve sensitive information and all experimental data are used for scientific research only.

Thank you for your cooperation!

Age: Gender: Grade: College: Major:

Options of each question range from 0 to 4, where 0 means 'Not apply to me at all' and 4 means 'Apply to me very much', please mark your answers with based on your real condition :)

| | | | | | | |
|----|---|---|---|---|---|---|
| 1 | Do you always feel hard to have a rest for a long time? | 0 | 1 | 2 | 3 | 4 |
| 2 | Do you think the existing administration system is reasonable? | 0 | 1 | 2 | 3 | 4 |
| 3 | Are you living in-campus or not? | 0 | 1 | 2 | 3 | 4 |
| 4 | Do you often waste your time? | 0 | 1 | 2 | 3 | 4 |
| 5 | Do you have good self-learning skills? | 0 | 1 | 2 | 3 | 4 |
| 6 | Do you feel stressed to pursue your ideal academic performance? | 0 | 1 | 2 | 3 | 4 |
| 7 | Do you worry about your financial condition? | 0 | 1 | 2 | 3 | 4 |
| 8 | Do you always play with your friends? | 0 | 1 | 2 | 3 | 4 |
| 9 | Is your sleep quality good? | 0 | 1 | 2 | 3 | 4 |
| 10 | Are you satisfied with your physical condition? | 0 | 1 | 2 | 3 | 4 |
| 11 | Is your mood often influenced by social connections? | 0 | 1 | 2 | 3 | 4 |
| 12 | Do you often tremble unconsciously? | 0 | 1 | 2 | 3 | 4 |
| 13 | Are you a lowerclassman or not? | 0 | 1 | 2 | 3 | 4 |
| 14 | Do you have a self-entertaining spirit? | 0 | 1 | 2 | 3 | 4 |
| 15 | Can you bear to be disturbed when doing something important? | 0 | 1 | 2 | 3 | 4 |
| 16 | Do you prefer working compared with studying? | 0 | 1 | 2 | 3 | 4 |
| 17 | Can you always maintain a good relationship with elders? | 0 | 1 | 2 | 3 | 4 |
| 18 | Are you an exchange student or not? | 0 | 1 | 2 | 3 | 4 |
| 19 | Is it difficult for you to slow down your pace of life? | 0 | 1 | 2 | 3 | 4 |
| 20 | Are you used to procrastinating | 0 | 1 | 2 | 3 | 4 |

