Cumulative Adversity: The Contribution of Correlated Stressors on Mental Health in College Students

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***Abstract*— Adversity comes in many forms, but the accumulation of these adversities and relationship among them have significant effects on mental health. This project focuses on examining the impact of these stressors in a sample of college students leveraging actively-reported data from surveys and passively-sensed data from phones and wearables collected in two phases of a study over two years. The goal is to find the correlations within and between several stressors using statistical data analysis and visualization in order to create a model for the relationship between adversity and mental health in college students. Initial results show that there are significant factors that contribute to mental health in college students, but there is more to be explored.**

I. Introduction

This work was a collaboration with two graduate Ph.D. students, one in computer science and the other in psychology, a postdoctoral student in mathematics and computer science, an undergraduate student in computer science, and several faculty from computer science and psychology who are serving as principal investigators in this project, all from the University of Washington. I work in a group of four, including the Ph.D. student in computer science, the undergraduate student, and the postdoctoral student.

The difficulties accompanied with college life are not uncommon for many college students. The various changes and decisions that students must go through when transitioning into college life can help them grow as an individual, but also can lead to stressful situations. The accumulation of various adversities college students face can have a significant impact on mental health. Adversities in this context includes discriminatory events, traumatic events, such as illness, injury, abuse, assault, [1] and physical health problems [2]. The surveys administered throughout the course of the two phases of the study included several standard scales that measure the aforementioned adversities in addition to other information about the participants, such as coping [3], rumination [4], and loneliness [5]. The surveys on which we focused in the beginning of this work were those surveys administered at different points throughout the study, such as before, during, and after the study. The other kind of survey in the study was a bi-weekly one on which we were not able to work during the summer, but that will be analyzed as this work progresses.

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We first performed extensive data cleaning and preparation on the data collected from the surveys in order to be able to process and analyze it. The surveys contain several standard scales, such as the UCLA Loneliness Scale [5] and the Cohen-Hoberman Inventory of Physical Symptoms (CHIPS) [2], but there were some for which our team had to create a scale and scoring scheme, such as Major Life Experiences (MLE), as they were not measured according to a standard scale, but instead were created for the study and had to be scored based on what information we wished to acquire. These scores were then used to create regression models. We analyzed these models to narrow down our selection of variables in order to decide which input variables relating to adversities best explained the change in the output variables relating to mental health. This project is ongoing and the final variables have not been completely selected for the question presented in this research, thus we have not yet created the model relating to our research question. However we have initial results that do bear significance.

II. Related Work

The standard scales used in the study surveys outline previous research done on these distinct variables and explain why these specific survey questions give any insight into mental health and adversities. The primary scales used in our preliminary analysis along with the shorthand acronyms used to refer to the respective scale are outlined below:

- State-Trait Anxiety Inventory for Adults (STAI) [6]
- Beck Depression Inventory-II (BDI-II) [7]
- Center for Epidemiologic Studies Depression (CES-D) Cole Version [8]
- Post-traumatic Stress Disorder Checklist for DSM-5 (PTSD) [9]
- Perceived Stress Scale (PSS) [10]
- Adverse Childhood Experiences (ACE) [11]
- Major Experiences of Discrimination (MED) [1]
- Everyday Discrimination Scale (EDS) [12]
- Chronic Work Discrimination and Harassment (CED-H) [13]
- Major Life Events (MLE)
- Brief COPE [3]
- Emotion Regulation Questionnaire (ERQ) [14]
- Mindful Attention Awareness Scale (MAAS) [15]
- Brief Resilience Scale (BRS) [16]
- Flourishing Scale and Psychological Well-Being Scale (FSPWB) [17]

- 2-Way Social Support Scale (2waySSS) [18]
- UCLA Loneliness Scale (UCLA) [5]
- Short-Form Health Survey-12 (SF-12) [19]
- Cohen-Hoberman Inventory of Physical Symptoms (CHIPS) [2]

The output variables used in our preliminary analysis were STAI [6], BDI-II [7], CES-D [8], and PTSD [9]. These four scales, respectively measuring anxiety [6], depression [7, 8], and post-traumatic stress disorder symptoms [9], are the key output variables for mental health. According to Bieling [6], the STAI measure, which is predominantly used to measure anxiety, can be also used to measure depression. The STAI measure contains questions that assess anxiety and worry in addition to sadness and self-depreciation [6]. The BDI-II scale [7] is a well-known scale used to measure the severity of depression in addition to suicidal behavior. Cole [8] developed the CES-D short form to assess depression in a general population. The PTSD scale [9] measures DSM-5 symptoms of PTSD in order to provide a tentative diagnosis for PTSD as a mental health disorder. These four measures provide the basis for the output variables used in this research due to their relationships with mental health overall.

The remaining scales listed are used as the input variables, which is the ongoing portion of this work, as the final list of input variables is still to be decided. Nevertheless, the remaining scales measure several aspects of adversity that have been linked in some way to mental health based on the previous research done in the creation of each of these scales.

We used statistical analysis to select the variables that best explain the change in the output variables and create regression models to show the correlationship between various adversities and mental health in college students.

III. Method

The first step was to prepare and clean the data collected from the surveys. In order to do so, we had to remove submissions that were submitted past the respective survey due date, remove submissions that were incomplete, and remove duplicate surveys after analyzing the number of responses in each duplicate to ensure the correct and more accurate entry was being kept in the data. To be able to read the data more clearly, we created renaming schemes for all columns in the raw data and removed irrelevant columns that would not be needed for this work.

The next step was to prepare the items in the scales for scoring by matching the response values in the raw data across surveys to ensure that scoring was consistent across all surveys and with the references from which the scale was obtained. In addition, we had to write scoring functions for the preliminary scales to be included in the initial regression models. We relied on the papers from which we obtained the scales to create the scoring functions and reverse some items within scales that needed to be the opposite score in order to count for the score.

Writing the scoring functions for the non-standard scales proved a challenge. For example, MLE is not one of the standard scales, so we had to create and write a scoring function based on the information we wanted to gain from this scale. Our team decided to group the MLE items into three groups; ”big T” trauma, ”small t” trauma, and ”total” trauma based on a recommendation from the psychologist principal investigator in our team. We did not base these groupings off of any previous work. ”Big T” trauma includes items from the MLE scale that asked about experiences of assault, violence, sexual assault, rape, and others, whereas ”small t” trauma includes items that asked about being ridiculed and having financial issues. ”Total” trauma contains all the items in the MLE scale, including ”big T” and ”small t” trauma. Because MLE is not a standard scale, the way the questions are asked in each survey differed. For example, one survey asks the participant to select one of the following options: the event had happened in the participant’s past life but not in the past year, in the past year but not in the past quarter, and in the past quarter, or never. On the other hand, another survey contains the same options but allows the user to select all that apply, introducing a multi-time aspect to the question. Other surveys only ask the participant to identify whether the event happened in the past quarter or not. Because of these differing contexts for the MLE scale, we decided to calculate three scores for MLE to attempt to gain all the information possible; a simple binary score to measure whether any event happened or not at any time point, a multi-time score to measure the average number of time frames in which the event happened, and a simple quarter score to measure whether the event happened in the past quarter or not.

Once the data preparation, cleaning, and scoring were complete, we created and analyzed score distributions for all the scales we used and a correlation heat map, Figure 2, to identify the scales we wished to analyze first and those we wished to remove altogether. Then we created multiple regression models to address the many changes we decided upon after analyzing each iteration of the changes. This process is ongoing as we are still analyzing different models to select the input variables that most explain the changes in the output variables based on the statistical significance in the regression models generated.

IV. Results and Analysis

After cleaning and processing the data, we visualized the distributions for all the scales. We analyzed whether the distributions for the output variables, STAI [6], BDI-II [7], CES-D [8], and PTSD [9], were normal or close to normal distributions in order to ensure that these scales were standardized in preparation for statistical analysis. These distributions can be seen in Figure 1. Based on the recommendations from our principal investigators, we decided that STAI [6], BDI-II [7], and CES-D [8] had acceptable distributions, however we decided to do some transformations on PTSD [9] to be able to analyze it better

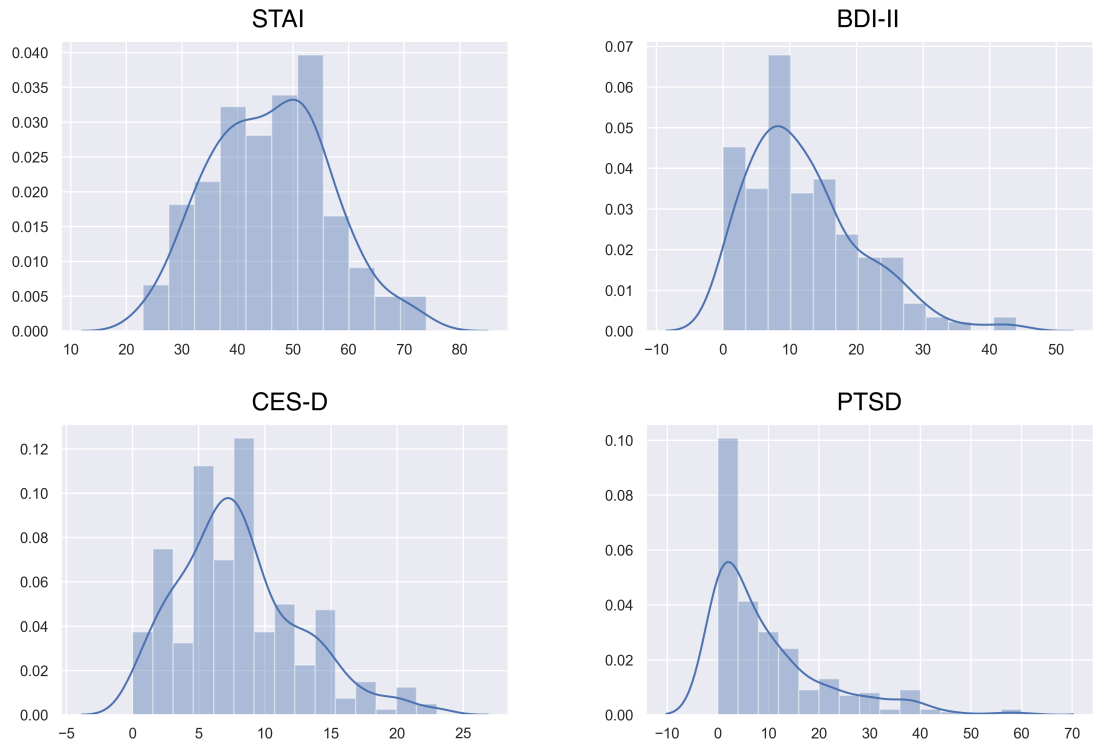

Fig. 1: Output Variable Distributions

since it was very zero-inflated for this sample. First, we did a logarithmic transformation, however that proved unhelpful as it had the same issue of zero-inflation. Then we created two versions of PTSD [9] based on a score threshold that indicates PTSD symptoms, as suggested by a psychologist on the team based on our sample's scores. The first version compares the bottom two-thirds and the top one-third of the data based on the cutoff of PTSD clinical symptoms [9], with the top one-third scoring above a preset threshold and the bottom two-thirds scoring below that same threshold. The second version compares the top one-third and bottom one-third of the data, which does drop one-third of the data and may yield less statistical power, but we wanted to analyze and compare both. The team is still working on using these two transformations.

After analyzing the distributions of the output variables, we created a correlation heat map of all the primary scales scored in one single survey, which can be found in Figure 2. In this heat map, the color scale on the right refers to the p-values, and cells with colors closer to white have p-values closer to 0.0, and thus high statistical significance. The cells with darker tones are those variables with low statistical significance.

We then ran regression models for each of the output variables using a subset of the input variables in the heat map. Based on the correlations in the heat map, we decided only to use the variables listed in Table 1. We used the variables PSS [10], ACE [11], MED [1], MAAS [15], BRS [16], FSPWB [17], 2waySSS [18], UCLA [5], and CHIPS [2] as they are, and used the emotion-focused, problem-focused, and dysfunctional sub-scores for BriefCope [3], both sub-scores for ERQ [14], both sub-scores for RRQ [4], and only the Physical Component Summary (PCS) sub-score of SF-12 [19]. We combined the EDS [12] and CEDH [13] because of how similar the scales are and the respective correlations among other variables in the heat map. We did not include any of the sub-scales for MLE in the regression models shown in Table 1 as we were still deciding on how to score MLE as it does not follow a standard scale.

Based on the results in Table 1, we created different models to experiment with certain variables dropped and other sub-scores included for certain scales. For example, once MLE was prepared, we decided to combine MLE with MED in order to perhaps get better results in terms of statistical significance. We also removed SF12_PCS [19], both ERQ scores [14], and both RRQ scores [4], and experimented with using the BriefCope mal-adaptive and adaptive sub-scales instead of the emotion-focused, problem-focused, and dysfunctional sub-scales [3]. We also experimented with using the 2waySSS [18] sub-score focused on receiving and removing the FSPWB scale [17] completely.

V. Discussion and Future Work

The next step of the project will be to narrow down our variable list further and experiment with the MLE and BriefCope [3] scales. The next regression model will contain different combinations of MLE sub-scores, including

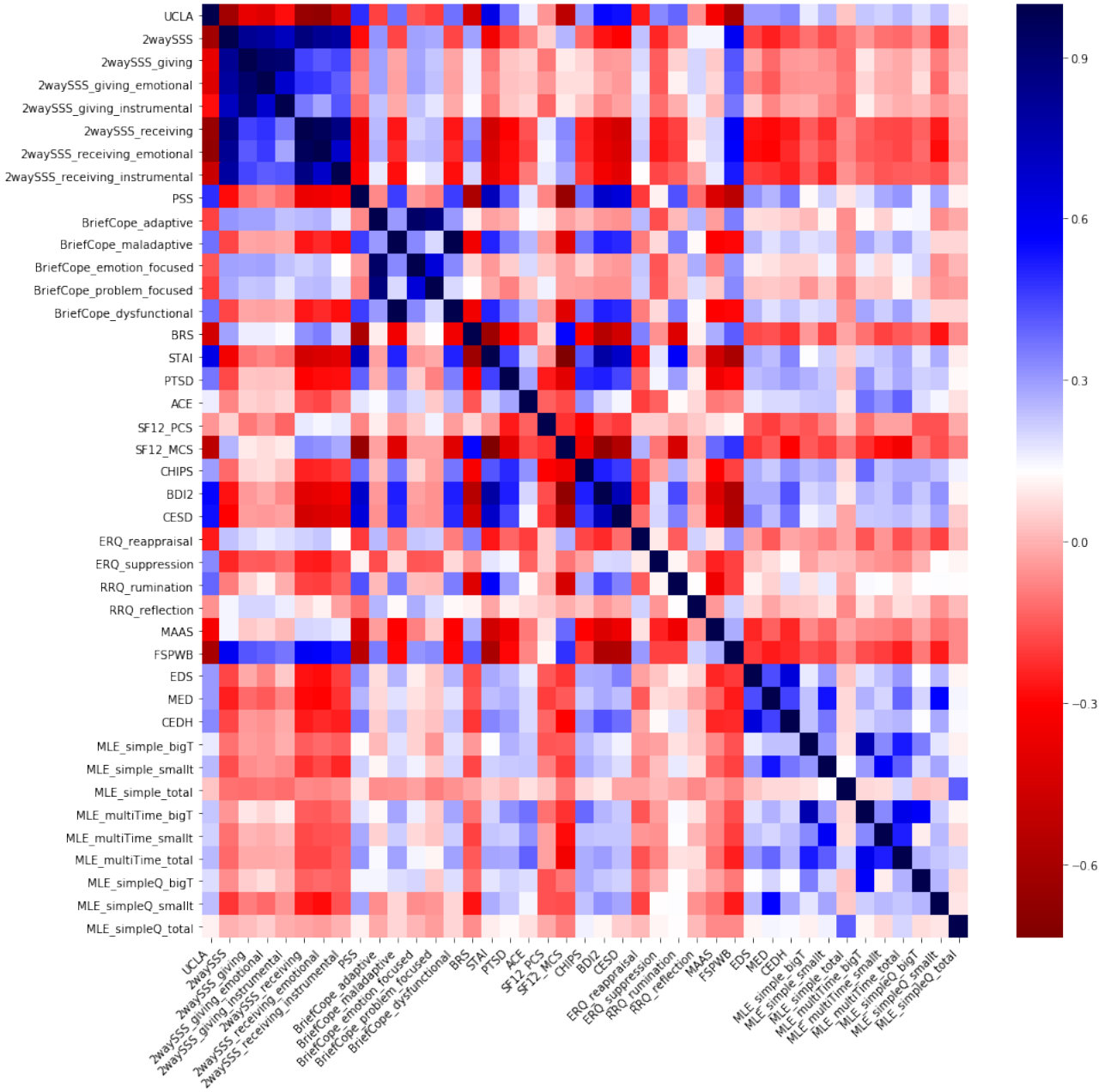

Fig. 2: Preliminary Correlation Heat Map

simple, simple quarter, and multi-time scores, and different MLE groupings, including ”big T”, ”small t” and ”total” MLE, as explained previously. In addition, the team will use different combinations of the three- or two-category BriefCope scale, namely mal-adaptive and adaptive or emotion-focused, problem-focused, and dysfunctional [3]. The team wants to experiment in this manner to avoid including variables that overfit the output variables before finalizing the variable list.

Regarding output variables, given that so few input variables in the PTSD [9] regression model were statistically significant, the team will create future regression models using the two approaches described previously, namely the bottom-two-thirds and top-one-third version and the top-one-third and bottom-one-third version. The goal is to find more correlationships when approaching the PTSD [9] scale these different ways, given that our sample does not include any extreme PTSD clinical symptom scores.

Once we are able to finalize the variables, the team will start looking at the other kind of survey that was administered bi-weekly throughout each phase of the study. In addition, the team will look at the actively-reported data from the wearables that were given to participants and their phones in order to track their sleep patterns, phone usage, and their activity. With data from all three of these sources, the goal is to analyze the data as a whole in

TABLE I: Preliminary Regression Models

Input Variables	p-value			
	STAI	BDI-II	CES-D	PTSD
PSS	7.63e-06	3.37e-05	1.42e-05	0.122072
ACE	0.351007	0.90105	0.29669	0.067924
MED	0.951702	0.99940	0.16580	0.250737
EDSCEDH	0.995967	0.20645	0.03982	0.582132
BriefCope_emotion_focused	0.051814	0.32653	0.19521	0.539052
BriefCope_problem_focused	0.000253	0.05322	0.02554	0.564994
BriefCope_dysfunctional	0.144017	0.02724	0.00931	0.331468
ERQ_reappraisal	0.879663	0.64223	0.10815	0.593343
ERQ_suppression	0.540339	0.02607	0.07111	0.176612
RRQ_rumination	4.92e-07	0.21580	0.76804	0.423587
RRQ_reflection	0.282811	0.53269	0.18798	0.064010
MAAS	0.021752	0.456348	0.66417	0.827085
BRS	1.28e-05	0.02108	0.33087	0.961029
FSPWB	1.17e-07	8.64e-08	4.73e-07	0.646706
2waySSS	0.044571	0.00149	0.05780	0.375492
UCLA	0.000979	0.04125	0.01238	0.158418
SF12_PCS	0.482790	0.26373	0.00890	0.025381
CHIPS	0.048016	2.02e-06	7.40e-05	0.000162

order to answer the research question, that being whether the accumulation of adversities contributes in a significant way to mental health in college students. However, based on the preliminary results, there are some variables exhibiting statistical significance in each model generated. The PSS [10] and UCLA [5] scales have very small, and in some cases, almost zero p-values in the STAI [6], BDI-II [7], and CES-D [8] models in every iteration of the regression models we have thus far, suggesting that these scales are highly correlated. Thus, based on these results, the more perceived stress and loneliness an individual experiences, the more anxious and depressed they may feel, contributing to the individual's mental health overall. However, since these are only preliminary results, the team has yet to draw any conclusions on these data.

As the team continues to generate better regression models, the goal is to find the most statistically significant correlationships within and between the stressors faced by college students in order to demonstrate their accumulated contribution to mental health. We hope this research enables us to discuss which resources are most pertinent to college students and understand which we have yet to implement to better serve college students amidst their struggles in university.

VI. Contact Information

If you have questions or suggestions regarding this document, please contact Olivia Figueira at ofigueira@scu.edu or Dr. Jennifer Mankoff at jmankoff@cs.washington.edu.

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