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PAIN, DEPRESSED MOOD, AND ACADEMIC PERFORMANCE IN UNDERGRADUATE STUDENTS WITH CHRONIC PAIN

SARA S. MANETTA
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Reviewed and approved* by the following:

Jennifer E. Graham-Engeland
Associate Professor of Biobehavioral Health
Thesis Supervisor

Lori A. Francis
Associate Professor of Biobehavioral Health
Honors Adviser

* Signatures are on file in the Schreyer Honors College.

ABSTRACT

The high comorbidity rates of chronic pain and depression have been well documented. Chronic pain and depression are both complex phenomena that can have significant effects on physical and psychological health and which can be exacerbated by stress. However, little research has examined the relationship between chronic pain and depressed mood among undergraduate students, despite prevalence rates of depression in college students that are similar to other populations and relatively high rates of perceived stress among college students. The goal of this study was to examine the complex relationship between chronic pain experience and depressed mood among undergraduate students and to investigate how both affect academic performance.

As a part of a larger study conducted at Penn State University, self-reported measures of pain, depressed mood, perceived stress, and academic performance were collected from 206 students with chronic pain. Chronic pain experience was measured by the McGill Pain Questionnaire (MPQ), providing ratings of sensory, affective, and evaluative, as well as other facets of pain. Depressed mood was measured by the Center for Epidemiologic Studies Depression (CES-D) Scale and its four factors—depressed affect, lack of positive affect, somatic, and interpersonal. MPQ subscales were compared to the CES-D subscales in college students with chronic pain in order to better understand the unique relationships between pain and psychological health. Lastly, the relationships between chronic pain, depressed mood and academic success was examined, with the expectation that depressed mood would mediate and account for any association between pain and performance. Academic performance was measured by grade point average (GPA) as well as a student's happiness with their grades and the extent to which they believed their grades reflected their ability.

Findings suggest a high prevalence of depression amongst college students with chronic pain. Total pain was most strongly associated with somatic and interpersonal depressed mood, while total depressed mood was most associated with affective and evaluative pain. Moreover, sensory and evaluative pain were more indicative of somatic and interpersonal depressed mood, while affective pain was linked to all aspects of depressed mood.

Various measures of pain and depressed mood were negatively correlated with academic performance. Pain severity and lack of positive affect were significantly associated with a student's happiness with their grades. Moreover, total depressed mood and somatic depressed mood were significantly related to both a student's happiness and expectations of grades based on their abilities. Structural equation modeling suggested that chronic pain relates to academic performance via depressed mood, with a significant and well-fitted model. Results were significant with and without controlling for perceived stress.

Overall, findings suggest an intricate relationship between chronic pain, depressed mood, and academic performance. It seems likely that pain contributes to depressed mood among undergraduate students with chronic pain and that their depressed mood contributes to poorer academic performance.

Keywords: Chronic pain, McGill Pain Questionnaire, depressed mood, MPQ, Center for Epidemiologic Studies Depression Scale, CES-D, academic performance, college students, undergraduates

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CHAPTER 1

Introduction

The comorbidity between chronic pain and depression has been well documented (Romano & Turner, 1985; Banks & Kerns, 1996). It is relatively common knowledge that there is a reciprocal effect between the two ailments; individuals with chronic pain disorders are more likely to be diagnosed with elevated levels of depressed mood or even clinical depression, while depressed mood can exacerbate a person's physical pain (Bair et al., 2003). Although the link between pain and depressed mood has been well defined, however, no studies have examined this particular relationship among college students with chronic pain.

College is generally considered to be high-stress environment, with many students concerned about their academic performance (Astin, 1993; Pritchard, 2003). Chronic pain and depressed mood play a significant role in a student's academic performance (Hammen & Cochran, 1981;); students with chronic pain as well as those with depressive symptoms often have poorer academic standings and lower grades than their healthy counterparts (Taras & Potts-Datema, 2005; Pritchard, 2003). While it is becoming increasingly evident that pain, depressed mood, and performance are related, the ways in which they interact remains unclear. The goal of the present research was to (1) look more closely at the unique relationship between chronic pain and depressed mood in undergraduate college students and then (2) to present a model by which chronic pain, depressed mood, and academic performance relate, with the expectation that depressed mood would account for an association between pain and academic performance. Because perceived psychological stress has also been related to pain, mood, and performance (Banks & Kerns, 1996; Astin, 1993), it will be controlled in order to observe the unique effects of pain and depressed mood.

Pain among College Students

Commonly defined as constant or occasional pain lasting 3 months or more (Gatchel, 2007), chronic pain is a common and significant health problem among people of all ages. Recent epidemiological surveys indicate that chronic pain is prevalent in 30.7% of adults in the United States, affecting females (34.3%) slightly more than males (26.7%) (Johannes et al., 2010). Of those people experiencing chronic pain, 50% of them report pain daily (Johannes et al., 2010). Although older populations tend to be afflicted at higher rates, people ranging from 18-24 years old have a 12.4% self-reported prevalence rate of chronic pain (Johannes et al., 2010). This age group of participants are often neglected in pain research and, therefore, little is known about the epidemiology, experience, and mechanisms by which the condition progresses in young adults.

Chronic pain is often viewed as a one-dimensional characteristic dependent on severity (Mezlack, 1975). The McGill Pain Questionnaire (MPQ) was developed to provide a more nuanced perspective into chronic pain experience. The MPQ measures pain through 20 subclasses of descriptors that can be broken down into sensory, affective, and evaluative subscales. These subscales are indicative of different physical, emotional and cognitive aspects of pain, providing a broader, more complex and more relevant view of pain experience. The MPQ has been shown to differentiate between various physical and psychological disorders through relative scores of sensory, affective and evaluative subscales that describe the unique, corresponding pain experience (Mezlack, 1975; Price et al., 1987). It can be used to help categorize psychological disorders, such as depression, based on the pain measures (Geisser et al., 1994; Galloway, 2012). Additional research is needed to understand how sensory, affective, and evaluative components of pain related to depressive symptomology.

Depressive Symptomatology and Stress among College Students

Depression is one of the most common mental disorders in the United State and can have a significant impact on personal health and well-being. College can be a particularly stressful time in the life of a young adult, which may explain the prevalence of depression among college students. Adults ranging from 18-24 years old recorded the highest prevalence rates for "other" depression, clinical depression classified as other than major depression (Gonzalez and Berry, 2010).

Penn State's Counseling and Psychological Services (CAPS) serve over 2500 students each year, half of which are diagnosed with a mood disorder such as depression (Penn State, 2003). However, in general, the majority of college students do not seek help for psychological disorders (Eisenberg et al., 2009). Therefore, the number of students utilizing the CAPS program is most likely an underestimate of those students who really need help. This may be representative of universities nationwide, where a large student population may contribute to the ineffective outreach programs and overall low treatment rates.

College is an academic experience that has been associated with positive outcomes in student learning and personal growth (Astin, 1993). However, college can be a very stressful time for students who are striving for good grades and taking difficult coursework. Academic stress is increasing among college students nationwide (Sax, 1997; Misra & McKean, 2000); these types of stressors include extensive knowledge-based requirements and inadequate time (Misra & McKean, 2000). Furthermore, the stress of college life has been strongly linked to academic performance (Pritchard, 2003). College life may have stressors that exacerbate both pain and the symptoms of depression. Stress measures have been linked to both chronic pain and depression separately (Hammen & Cochran, 1981).

Association between Pain and Depressive Symptomatology

It is well documented that chronic pain and depression are strongly related (Romano and Turner, 1985; Banks and Kerns, 1996). Chronic pain sufferers are more likely to be depressed than both healthy individuals and other chronically ill individuals (Banks and Kerns, 1996; Johannes et al., 2010). Although chronic pain and depression have frequently been associated in both clinical and investigative settings, some controversy exists over the extent and mechanism of the relationship (Banks and Kerns, 1996). Chronic pain and depression seem to have a mutual causal effect, where the presence of one affects the outcome of the other. A meta-analysis found that aspects of the pain, including, increased severity, interference with daily living, and frequency of episodes, were associated with worse depression outcomes (Bair et al., 2003). While most studies agree that pain can have a causal effect, some suggest that it is not the pain but the reduced daily functioning that is correlated with depression (Von and Simon, 1996). Furthermore, depression also exacerbated pain outcomes, leading to worse pain symptoms and poor prognoses (Bair et al., 2003).

The association between chronic pain and depression is further complicated by the fact that they share similar symptomology (Banks and Kerns, 1996; Bair et al., 2003). Aspects of sensory pain measured by the MPQ, which is descriptive of physical symptoms, may overlap with the somatic depression measure of the CES-D scale. This co-occurrence of physical symptoms in pain and depression may inflate both the MPQ pain and CES-D depressed mood measures.

Chronic pain subscales (such as those measured by the MPQ) have been compared to aspects of depressive symptomology among various populations, including chronic pain patients, in order to understand the nuanced relationship between the two concepts. Previous studies have

compared relative degrees of depression, including non-depressed, mild, and moderate/severe depressed patients, and MPQ sensory, affective, and evaluative indices. Findings included significant relationships between depressed mood and the number of sensory descriptors (Doan and Wadden, 1989). Furthermore, this study was able to used MPQ sensory subscale scores to differentiate between non-depressed and depressed patients with 78% accuracy (Doan and Wadden, 1989). Another study found significant correlations between depression measures and both the sensory and affective subscales (Geisser et al. 1994). These two studies performed basic analyses on the relation of depression and the subscales of the MPQ, focusing on other aspects of the relationship than the present study. Both studies were also conducted on relatively small sample sizes ($n < 85$) using the Beck Depression Inventory as a measure of depressed mood, rather than the CES-D, thus not enabling comparisons between MPQ and specific aspects of depressed mood.

A more recent study examined the relationship between depressed mood measured by the CES-D, trait anxiety, and the subscales of the MPQ in breast cancer patients. Findings showed the intricate relationship between these two concepts (Galloway et al., 2012). Results show that anxiety served as a predictor of sensory pain, while depressed mood served as a predictor of affective pain (Galloway et al., 2012). This study has shows that the MPQ can differentiate between types of psychological measures.

Although previous research shows a strong relationship between chronic pain and depression, the relationship between specific aspects of pain and depressive symptomatology remains inconclusive and has not been examined in college students. College students have a significant presence in the chronic pain population, yet there have been few studies of the

prevalence of the chronic pain and its implication in psychological health in this particular age range or group of people.

Pain, Depressive Symptomatology, and Academic Performance

Academic performance and chronic pain have been associated in several studies examining several chronic conditions. Chronic illness impacts various areas of academic development including academic performance, self-esteem, and access to educational opportunities (Shiu, 2001). Chronic illnesses, including chronic pain, diabetes, sickle cell anemia, epilepsy, migraine, chronic abdominal pain, and juvenile arthritis, are correlated to frequent school absences, and decreased ability, grades, and overall student success (Taras & Potts-Datema, 2005; Palermo, 2000; Logan et al., 2008). Students with recurrent or chronic pain tend to have higher rates of absences than other chronic health conditions (Palermo, 2000). Unfortunately, most, if not all, of the studies linking academic performance and chronic pain examine these concepts in adolescents ranging from age 12-18. There has been no recent research that has examined academic performance in college students with chronic pain.

The findings reviewed above suggest a strong relationship between chronic pain and poorer academic performance. However, little research has been conducted to understand the psychological pathway by which one affects the other. A likely candidate for the mechanisms underlying this relationship is depressed mood. Depressed mood, particular its somatic and cognitive aspects, may be the connection between pain and academic achievement.

Academic performance has also been associated with depression in college students. College students' academic performance has previously been predicted by emotional and psychological factors seen in this analysis, correlating depression and academic performance measures (Haines et al., 1996; Pritchard, 2003). In a study examining depressed mood and

suicidal tendencies in college students, researchers found that 53% of survey participants indicated experiencing self-assessed depression since the beginning of college, citing causes such as problems with grades, loneliness, money problems, and interrelationship problems (Furr et al., 2001). While problems with grades were the leading cause of depressive symptoms (cited by 53% of students), it is interesting to note that it was ranked seventh out of nine possible causes for suicidal ideation (Furr et al., 2001). These findings highlight the unique relationship between depressed mood and academic performance.

Overview of Current Research

There is a lack of research relating chronic pain and depression with academic performance in college students. While both chronic pain and depression are serious problems in college-aged populations, few researchers have examined the consequences of these ailments on academic success and grades. The current study seeks to describe pain experience, depressed mood and academic performance in college students. The research closely examines the correlations between the sensory, affective and evaluative pain subscales and depressed mood subscales to better understand the relationships between chronic pain and depression.

I expected to find an overall positive correlation between chronic pain and depressed mood measures, with various pain indicators differentially relating to depression indicators. I expected that that similar variables, such as sensory chronic pain and somatic depressed mood, would have particularly robust associations. Furthermore, both chronic pain and depressed mood were expected to be negatively associated with academic performance. Finally, I expected that depressed mood would explain the effect of chronic pain on academic performance.

CHAPTER 2
Methods

Procedure

Overview

As part of a larger study on the associations between mood, behavior, beliefs, and pain among undergraduate students with and without pain, participants completed an hour-long online survey. The survey included a total of 31 scales of self-reported measures. The survey was distributed to undergraduate Penn State students at the University Park campus in the beginning of the Fall 2012, Spring 2012, and Fall 2013 semesters. The only inclusion criteria was that participants were undergraduate students and 18 or older. Students were recruited from participating classes and were offered extra credit for completing the survey. Institutional Review Board approval and individual consent was obtained prior to the administration of the survey.

Data Cleaning

Only students with self-reported chronic pain were included in the current analyses. As part of initial data cleaning, listwise deletion of records was used for those who repeated the survey multiple times; the more complete response was kept or, if both responses were complete, the response submitted first was kept under the assumption that the participant's familiarity with the survey might have changed the results. Participants who did not complete the relevant scales to this analysis (namely, pain, depressed mood, pain, and academic performance) were excluded from the study. After these steps, 206 participants with chronic pain were available for evaluation.

Measures

Chronic Pain

Chronic pain has been described as persistent pain lasting more than 3 months and reoccurring pain lasting more than 6 months (Gatchel, 2007). For the present study, chronic pain was defined as "pain that persists or comes and goes over 6 months or more." Chronic pain was measured by the McGill Pain Questionnaire, which categorizes the pain in sensory, affective, evaluative and miscellaneous subscales (Mezlack, 1975).

The subscales are composed of groupings of descriptor words that reflect the physical, emotional or cognitive aspects of pain. The sensory subscale includes temporal, spatial punctate pressure incisive pressure constrictive pressure, traction pressure, thermal, brightness, dullness and miscellaneous pain groupings; the affective subscale includes tension, autonomic, fear, punishment and miscellaneous pain groupings; the evaluative subscale is composed of one all-encompassing descriptor grouping (Mezlack, 1983). As seen in Appendix A, there are a total of 20 groupings categorized by meaning and ranked by assigning increasingly intense words to higher values. An example of a word grouping includes (1) "hot," (2) "burning," (3) "scalding," (4) "searing," where "searing" signifies the most intense thermal pain experience. The sensory, affective and evaluative subscales are comprised of the first 16 groupings. The miscellaneous subscale was comprised of the last 4 groupings, which were supplementary questions added to the MPQ at a later time point. Participants were asked to choose descriptor words representative of their personal pain experience; there were no forced responses, so blank answers were coded as zero. Otherwise, the subscales were summed totals of relevant descriptor values. The sensory subscale ranges from 0-42, affective subscale from 0-14, evaluative from 0-5, the miscellaneous subscale ranges from 0-17 and the total chronic pain score, also referred to as the Pain Rating

Index (PRI), ranges from 0-78. A higher score indicates a more intense pain experience in the given category.

The descriptor groupings had a high level of agreement among subjects with different cultural, socioeconomic and educational backgrounds, contributing to the overall validity and consistency of the MPQ (Mezlack, 1983). These finding suggest that the MPQ is a useful tool for describing a pain patient's symptomatic response.

Depressed Mood

Depressed mood was measured using the Center for Epidemiological Studies Depression Scale (CES-D) (Radloff, 1977). As seen in Appendix B, the scale consists of 20 questions designed to measure depressed mood over weekly intervals, with response values ranging from (0) "rarely or none (less than 1 day)" to (3) "most or all of the time (5-7 days)." The CES-D was developed to measure a depressed mood gradient in a general population, including both levels that could be considered "normal" and clinically depressed (Radloff, 1977).

According to the Center for Epidemiologic Studies Depression Scale (CES-D), indicators of depressive symptomology include mood, helpless or hopeless feelings, loss of appetite, disturbed sleep, and mental and physical lethargy (Radloff, 1977). These indicators as measured by the CES-D scale can be factored into four subscales of depressed mood: depressed affect, somatic, lack of positive affect, and interpersonal. Depressed affect was indicative of blues, loneliness and sadness. The somatic subscale included items of poor sleep or appetite and difficulty getting going. Lack of positive affect included items measuring lack of hope, happiness, and enjoyment. Lastly, the interpersonal subscale was suggestive of dislike and unfriendliness. After reverse coding 4 items, the scale values were summed; depressed affect, somatic, lack of positive affect, interpersonal, and total scores had possible maximum values of

21, 21, 12, 6, and 60, respectively, with a higher score indicating a stronger tendency towards depressed mood. The total score was an estimate of the degree of depressed mood, while the subscale scores were representative of the type of depressive symptomatology.

The CES-D scale has been proven to be a reliable measure of depressed mood in both healthy and chronic pain patient (Geisser et al., 1997; Turk & Okifuji, 1994) and can be used to differentiate between depressed feelings and clinical depression. Studies mark a total score of 16 or more to signify clinical depression (Radloff, 1977), however cut-off score of 19 is more appropriate for a population of chronic pain patients (Turk & Okifuji, 1994). Studies suggest that chronic pain respondents tend to have higher somatic subscale scores, reflecting their physical pain, and therefore require a higher cut-off to prevent overestimating the pervasiveness of clinical depression in chronic pain populations (Turk & Okifuji, 1994). Furthermore, the CES-D scale is valid measure of depressed mood in both young adults and undergraduate students (Radloff, 1991).

Perceived Stress

Stress was assessed in order to control for its effects on performance. The Perceived Stress Scale (PSS) was used as a subjective measure of tendencies to perceive life experiences as stressful (Cohen et al., 1983). The scale is comprised of 10 questions about the frequency of stressful situations with response options ranging from (0) “never” to (4) “very often.” After reverse-coding 4 scales items, the scale was totaled. The higher scores represented more self-reported stress and less ability to cope with appraised stressful life events. The PSS is a distinct construct closely related to both depressive and somatic symptomatology; it is widely used with consistent, reliable results among college student populations (Cohen et al., 1983).

Academic Performance

Academic performance was assessed through three aspects. Along with (1) self-reported GPA, the participants were asked to describe (2) their happiness with their grades and (3) how well they think their grades reflect their abilities. Academic success as measured by contentment and ability was scored on a scale from 1-10 with high scores suggesting a more positive outlook on the performance. By utilizing GPA and appraisal questions, this constructs contains both objective and subjective measures of academic achievements. While academic performance was not measured by a pre-designed scale, the appraisal questions, "How happy are you with your grades?" and "How well do your grades reflect your abilities?" reflect a measure of academic self-efficacy, self-concept and expectancy beliefs that has been positively correlated with academic success in college students (Choi, 2005; Wood & Locke, 1987). Grade expectations were generally predictive of final course grades and academic performance, even after controlling for GPA (Svanum & Bigatti, 2006), indicating that GPA and grade expectations are relatively good predictors of academic performance in college.

Data Analysis

The McGill Pain Questionnaire and Center for Epidemiological Studies Depression Scale were examined in relation to aspects of college life, such as stress and academic performance. The scales were coded and data was cleaned and analyzed using SPSS 21. The data was screened for abnormalities and tested for normality. All variables demonstrated normality except for age, which skewed to the left due to the age requirement for the study and the common age range for college students. Frequencies and descriptive statistics were run for demographic information and key variables. Pearson bivariate correlation coefficients were calculated for chronic pain, depressed mood, stress, and academic grade variables, as well as suspected covariates. These

covariates were identified as age, gender, and, most significantly, socioeconomic status. Pearson correlation tests were primarily conducted to examine the unique associations between individual subscales of pain and depressed mood, in order to better understand the nuanced relationship between the chronic pain experience and depressive symptomatology in chronic pain patients.

Lastly, structural equation modeling was performed using AMOS 20 to determine the affect of the relationship between pain and depressed mood on academic performance with particular focus on depressed mood as a possible mediator. Measurement models were created for chronic pain, depressed mood, academic performance, and stress latent variables. These latent variables were arranged to examine the extent to which depressed mood may account for the effect between chronic pain and academic performance. Modification indices were used carefully to ensure a best fit model; when this was done, theoretical considerations were assessed before accepting any modification and only one modification was made at a time.

Four indicators of model fit were considered, including the Tucker-Lewis index (TLI), comparative fit index (CFI), root mean square error of approximation (RMSEA) and chi-square (X^2) values. TLI and CFI values greater than 0.90 were indicative of a good fit and values greater than 0.95 were considered an excellent fit (Hu & Bentler, 1998; West et al., 2012). RMSEA values less than 0.10 were considered indicative of a good fit, with values less than 0.06 were representative of an excellent fit (Byrne, 2001; Hu & Bentler, 1998). The chi-square statistic is extremely dependent on sample size and "nearly always" rejects the model when analyzing large sample populations, which are necessary to give the model power to discriminate between good fitting and poor fitting models (Hooper et al., 2008). Therefore, the chi-square statistic is provided merely as a reference to compare between models. Structural equation modeling was performed with and without consideration for perceived stress to determine the validity of the

model outside the effect of stress. Furthermore, the model was conducted with and without the depressed mood latent variable in order to suggest a causal path through mediation.

CHAPTER 3
Results

Descriptive Statistics

As seen in Table 1, the mean age of the participants was 20.35 ± 2.080. Statistically, the majority of respondents were Caucasian women. Women represented 77.70% percent of the sample population, men represent 21.80% and a few participants declined to answer. The breakdown of gender and ethnicity seem to be representative of the recruitment pool and the university population, respectively; the college from which the participants were recruited was predominately women, while their ethnicity reflected that of the campus; Penn State University Park was approximately 70% Caucasian at the time of the survey (Penn State, 2014). Most participants self-identified as white (79.13%), but African Americans (10.19%), Hispanics (6.80%) and Asians (3.88%) were also represented in the sample.

Due to selection criteria, all of the participants in the study reported chronic pain. The causes and experiences of chronic pain varied between participants. Only 14.6% of participants reported pain from injury, 6.3% from disease condition, and 1% from substance abuse. The majority of students reported either unknown (30.1%) or more specific processes (48.1%), such as migraines and menstrual problems. The location of the pain also varied widely. The participants were asked to indicate where they experienced chronic pain, allowing them to choose more than one option. Of the 206 respondents, 37.86% had lower back pain (n =7 8), 26.70% had upper back pain (n = 55), 25.73% had headaches (n = 53), 18.45% had neck pain (n = 38), 11.17% had pain in the arms or legs (n = 23), 9.71% had pelvic pain (n = 20), 5.83% had pain in the hands or feet (n = 12), and, lastly, 2.43% participants report pain all over (n = 5).

People experience pain differently, which is reflected in the frequencies and descriptive statistics of the McGill Pain Questionnaire. The individual questions' frequencies and means quantify the most and least common descriptions of the populations pain. As seen in Table 2, the temporal, dullness, and constructive pressure pain (n = 166, n = 176, n = 159) descriptors were most frequently used to describe sensory pain, while tension (n = 137) and overall evaluative (n = 172) descriptors were most often used to describe affective and evaluative pain, respectively. Interestingly, the most frequently recorded descriptors also had the highest scores relative to their respective ranges, suggesting the participants only answered when they felt strongly about the word-experience association. On average, the participants chose words from 12 of the available 20 descriptor groups to describe their pain, as is recorded by the Number of Words Count total (Mezlack, 1975).

The sensory, affective and evaluative pain total scores also vary from one another as seen in Table 2. Chronic pain subscales scores varied widely within their given range. With respect to their possible ranges, sensory pain (M=16.82; SD=8.85) had the highest average score, followed by evaluative pain (M=1.76; SD=1.35), affective pain (M=3.81; SD=3.56), and lastly, miscellaneous pain (M=4.64; SD=3.88). Furthermore it is important to note that the MPQ Present Pain Index (PPI) and the MPI Pain Severity are equivalent measures of present pain severity. However, the PPI mean (M=1.43) was relatively higher than the MPI Pain Severity (M=1.44) because it measures pain severity within a smaller range from 0-5 versus 0-6 of the MPI. This suggests that the persistent or recurring chronic pain experience is generally more severe than the present pain of the participants when taking the survey.

The mean score of the CES-D total was 16.14 with a standard deviation of 10.00 out of a possible maximum score of 60. Mean scores of the CES-D subscales varied with the subscale's

range, similar to the MPQ. The mean scores of the depressed affect, somatic, lack of positive affect, and conflict subscales were 4.68, 7.23, 3.12, 1.11 (SD=4.31; 3.74; 2.77; 1.34), respectively. According to a proposed cut off of 19 for depression in chronic pain patients (Turk & Okifuji, 1994), about one third of the participants could be considered clinically depressed, and 44.66% would be considered clinically depressed based on the cut off of 16 typically used for a general population (Turk & Okifuji, 1994). Also, perceived stress had a mean of 18.52 with a standard deviation of 6.91 on a scale with a maximum score 40.

Measures of academic performance were straightforward. The average GPA for the sample population was 3.27 (SD=0.42). Participants' happiness with their grades was scored on a 10-point scale, resulting in a mean of 5.89 (SD=2.30). Similar results were seen when participants responded to whether or not they thought their grades reflected their personal abilities; the mean score was 5.35 (SD=2.53). These results suggest that subjective measures of the students' academic expectations were evenly divided.

Preliminary Findings

Correlations were determined between key demographic factors and key study variables. Neither age nor gender was significantly correlated with any of the variables of interest. This finding was to be expected with a relatively homogenous sample population. Age range is relatively limited in university setting with many students attending in their early twenties, as was the case with the present study. Women had comparable levels of pain, depressed mood, and academic performance. Although the lack of gender differences in depressed mood may seem surprising, previous research from Butler and Nolen-Hoeksema (1994) suggest that gender has limited impact on depression measures in college students. Thus, age and gender were not used as covariates in the subsequent analyses.

Correlations for all key variables are presented in Table 3. These correlation results show several important findings. First, the correlations help demonstrate the internal consistency of the MPQ scale, the CES-D scale and the academic performances measures. These scales and their subscales are closely related and significantly correlated, highlighting the cohesiveness of these concept measurements.

Second, the correlations provide insight into the unique interactions between subscales and specific measures of chronic pain, depressed mood and academic performance. Different chronic pain measures are correlated with some depressed mood variables and not others. The total MPQ score as well as sensory, evaluative and miscellaneous subscales were significantly correlated with the total CES-D score as well as somatic and conflict CES-D subscales (p's < 0.05), but not depressed affect or lack of positive affect subscales. The MPQ affective subscale is correlated with all measures of depressed mood, including CES-D total, depressed affect, somatic, lack of positive affect and conflict subscales (p's < 0.05).

Chronic pain was less directly correlated to academic performance than is suggested by previous research. None of the MPQ subscale scores were associated with any of the academic performance indicators (r = -0.15; p = 0.03). However, the MPQ scale's measurement of pain severity (not shown in Table 3), the Present Pain Index (PPI), was significantly correlated with a student's happiness with his or her grades. On the other hand, the relationship between depressed mood and academic performance was much more evident. The total CES-D score and the somatic subscale of depressed mood were significantly correlated with both happiness with grades and ability (p's < 0.05). The lack of positive affect CES-D subscale was negatively correlated with happiness with grades as well (p = 0.01). The CES-D depressed affect subscale

was not significantly related to measures of academic performance, and GPA itself was not related to measures of depressed mood.

Finally, stress was related to several factors. Perceived stress was significantly correlated with MPQ evaluative and miscellaneous subscales, total CES-D score, CES-D depressed affect, somatic, lack of positive affect, and conflict subscales, as well as academic performance measures of happiness and ability (p's < 0.05).

Measurement Models and Structural Equation Model

Measurement models were created for latent variables of chronic pain, depressed mood, academic performance and perceived stress to create better model fit. Chronic pain and depressed mood were each parceled into four predetermined subscales based on the original research on the McGill Pain Questionnaire and Center for Epidemiological Studies-Depression scale. Academic performance was parceled into three subscales based on the available three questions in our current study for examining success in school. The perceived stress latent variable was created by randomly parceling individual Perceived Stress Scale items into three factors, using an online random number generator. These four latent factors each individually met the minimum requirements for good fit for TLI, CFI, and RMSEA statistics. TLI and CFI values were more than 0.90 and RMSEA values were less than 0.10. Lastly, modification indices identified pathways between error variables that slightly improved this fit.

As seen in Figure 1, the structural equation model connected these concepts, examining the relationship between latent variable of chronic pain, depressed mood, and academic performance, while controlling for the effect of stress. The model was a good fit for the data ($X^2 = 94.158$, $p = 0.34$, TLI = 0.972, CFI = 0.981, RMSEA = 0.04). Furthermore, the model's paths between latent variables were all significant. The paths from chronic pain to depressed mood (β

= 0.263, $p < 0.001$), depressed mood to academic performance ($\beta = -0.165$, $p = 0.041$), as well as the relationship between stress and chronic pain ($\beta = 1.838$, $p < 0.001$), and stress and depression ($\beta = 1.62$, $p = 0.031$) were all statistically meaningful.

The data were obtained from one time point, making it impossible to test causality between variables. Further, depressed mood could not be examined as a mediator of an association between pain and academic performance because there was no direct relationship between pain and academic performance. However, the paths as tested were examined on a theoretical basis and are consistent with the perspective that pain may indirectly relate to academic performance via depressed mood. Pain was related to depressed mood, which was in turn related to academic performance. Further, these paths were examined in the context of psychological stress. Both pain and depressed mood were related to stress, but stress was not directly related to academic performance. The model was statistically significant and showed a good fit to the data regardless of the inclusion of stress.

CHAPTER 4
Discussion

As anticipated, there was a significant and complex relationship between pain and depressed mood in college students with chronic pain. There were a significant proportion of students with chronic pain that reported elevate depressed mood, 33% of whom could be classified as clinically depressed. Previous research suggests the 53% of college undergraduates experience self-labeling depressed mood (Furr et al., 2001), while 13.8% of undergraduates were clinically depressed (Eisenberg et al., 2007). The current finding of clinical depression among students with chronic pain is expected to be greater than that of the general undergraduate population because of the high comorbidity rate between depression and chronic pain. In conjunction with previous findings on chronic pain and depression, current research suggest that comorbidity of pain and depressive symptomatology is a serious problem among a sizeable minority of university undergraduates. However, there is little research already available on this comorbidity in college students for comparison.

After examining the prevalence, correlations were used to examine the nature of the relationships between of pain and depressed mood. Interestingly, the relation between pain components and psychological factors differed depending on which aspects were considered. Measures of chronic pain, including MPQ total, sensory, evaluative, miscellaneous scores were significantly related to CES-D total, somatic, and conflict scores. These results were expected: Previous studies suggest a strong generalized comorbidity between chronic pain and depression based on examination of such general measures of depressed mood and pain (Romano and Turner, 1985; Banks and Kerns, 1996; Bair et al., 2003). Sensory pain and somatic depressed mood are like to be associated because they measure similar physical symptoms (Bair et al.,

2003) and previous findings have noted significant correlations between the MPQ sensory subscale and depressed mood (Doan and Wadden, 1989). Evaluative pain and conflicted depressed mood are also similar in their focus on cognitive processes; evaluative pain is likely the result of rumination in the same way a participant might ruminate on conflict in their life. However, unexpected relationships between dissimilar subscales, such as sensory pain and conflicted depressed mood, and evaluative pain and somatic depressed mood were also found. These findings are particularly noteworthy as they suggest a unique crossover between physical and psychological processes underlying these diseases.

Affective pain was significantly associated with all measures of depression. While this result is in concordance with previous research findings linking the MPQ affective pain subscale to overall depressed mood (Geisser et al. 1994; Galloway et al., 2012), it is important to note that the affective pain subscale was most closely related to somatic depressed mood, rather than depressed affect, lack of positive affect, or conflict subscales. This suggests that pain may cause emotional distress or, conversely, that a person's emotional status can manifest in physical symptoms, such as pain. Overall, this finding highlights the significant emotional component of depression, which is primarily referred to as a psychological disorder.

The effects of stress was pervasive throughout measures of chronic pain, depressed mood and academic performance, and may account for the trend of increasing stress among college students (Sax, 1997). This highlights how important it is to understand the impact of stress on chronic pain and depression in college students, as well as to control for perceived stress in analyses with the aim of determining unique effects of pain and depressed mood on performance. Perceived stress was significantly correlated with evaluative pain, miscellaneous pain, depressed mood, somatic depressive symptoms, lack of positive affect, conflict subscales of the MPQ and

CES-D, as well as academic performance measures. These results suggest that stress may be a predictor of both disease symptomology and academic achievements alike, perhaps making college students afflicted with chronic pain particularly susceptible to harmful effects of stress.

Contrary to expectations, there was not a direct association between pain subscales and academic performance in the present research. However, there was a significant relationship between pain severity and grades. Previous research has found that chronic pain, along with other chronic illnesses, can have significant negative effect on an adolescent student's academic life (Shiu, 2001; Taras and Potts-Datema, 2005; Logan et al., 2008). One explanation is that the effect of chronic pain on academic performance is only dependent on the intensity of the pain. Another explanation for the lack of connection between pain and performance in the present research is that college students with chronic pain do not experience the detrimental effect on their academic performance to the same extent as adolescents.

Although our findings did do not support a direct association between pain and academic performance, there appears to be an indirect associations between both pain and academic performance as well as stress and academic performance. Using structural equation modeling to examine complex associations, pain was strongly associated with depressed mood in the present research, which was simultaneously associated with academic performance. Similarly, perceived stress was associated with pain as well as academic performance. These relationships suggest that chronic pain and stress have a negative impact on academic performance via depressed mood, with depressed mood relating to poor grades. It seems likely that students who have more pain become more depressed, possibly due to their physical symptomatology or due to life disruption from pain, and then their negative mood contributes to poor academic performance. Future research would benefit from additional investigation of the psychological and behavioral

mechanisms by which pain, depressed mood, and stress may contribute to poor academic performance.

Examination of measurements models the latent constructs of pain, depressed mood, and academic performance performed as expected. Despite the interesting correlations that emerged between subscales, the present study also determined strong internal consistency between the subscales of the MPQ and depressed mood as well as the academic performance items. This is important because it suggests that each of these scales can be viewed as a whole. This is particularly important for measures of academic performance, because it was not based on a pre-established scale, and speaks to the overall consistency of the study in its entirety.

Implications

The current research shows that students with chronic pain and depressive symptoms are at risk for poor academic performance. Although previous studies have documented various relationships between chronic pain, depressed mood and academic success, this research is the first to examine all three concepts in college students, a particular vulnerable and understudied population when it comes to pain. With such high prevalence of both chronic pain and depression among the study participants, outreach efforts should be considered to minimize the effects of these diseases on their academic performance. By targeting this specific comorbidity population, an outreach program could potentially identify, make contact, and provide help for at-risk students, ensuring they receive the same academic opportunities afforded to their health counterparts.

This technique of examining subcomponents of pain and depressed mood could have implications in diagnostics as well as community outreach. Chronic pain and depressed mood are so closely intertwined that identifying key components of one disease that are uniquely

indicative of the other could lead to an increased awareness of comorbid relationships and a decreased number of misdiagnoses. Depressed patients typically present with physical symptoms, such as fatigue, insomnia, and pain complaints rather than psychological complaints (Bair et al., 2003). More than half of people suffering from depression report only somatic complaints (Bair et al., 2003). This type of disease presentation is more often associated with an underlying medical illness rather than an underlying mood disorder. For this reason, depression is often overlooked or misdiagnosed by both the patient and their medical providers (Bair et al., 2003).

Looking for specific subscales scores of simple self-reported surveys or their equivalent disease symptomatology could help diagnose chronic pain patients with depression. As seen in the present research, for example, affective pain was statistically associated with all measures of depressed mood, suggesting that this specific subscale is a good indicator of depression; if chronic pain patients were screened for high affective pain scores, providers may be more likely to identify patients suffering from or at risk of developing depression. Because undergraduate students are less likely to seek help for psychological issues (Eisenberg et al., 2009), it is important to be able to identify those who may be vulnerable.

Limitations

Although the present research show that there are clear associations between pain, depressed mood, and academic achievement, the study's sample population and design limit its findings. Firstly, participants were homogeneous with respect to race, age, and gender, primarily being representative of white, college-aged women. While this was helpful in ruling out potential predictor variables, it limits the study's generalizability to men, other ethnicities, and other age groups. Further study would be needed to determine whether or not current findings could be

applied to alternative populations. In addition, all the measures in the study were self-reported. With subjective measures it is impossible to determine if the data was representative of actual experiences, self-deceptive ideas or complete lies.

The cross-sectional study design of the present research also limits the conclusions that can be drawn from the correlational analyses and the structural equation model that were examined. True mediation cannot be established with only one time point, and experimental designs with multiple time points are needed to determine causality. Further research would benefit from a more extensive and focused examination of depressed mood as a potential mediator of an association between pain and academic performance using multiple time points and/or in a controlled laboratory-setting experiment. It was also beyond the scope of the present research to examine moderation effects or psychological or behavioral mediators of associations determined.

Conclusion

There is a lack of research on chronic pain and depressed mood in college students, especially with regards to their effect on academic life. The results of the present study have examined the prevalence and relationships between pain, depressed mood, and academic performance in Penn State University undergraduates. As expected, there was a positive correlation between chronic pain and depressed mood, and a negative correlation between these two concepts and academic performance. Findings highlighted the intricate relationship between components of chronic pain and depressed mood, and their association with grades and academic achievements. Depressed mood appears to be a critical link between pain and grades as well as stress and grades.

This study has practical application in both improving diagnostic procedures and designing outreach programs to target at-risk students that provide needed services, such as academic assistance, psychological counseling and coping strategies seminars. Before engaging in extensive outreach programs, however, it would be advantageous to expand research efforts to more diverse demographic populations over an extend time period. A better understanding of the unique relationship between chronic pain and depressed mood and their effect on academic performance may significantly improve our ability to provide this specific, underserved population of students with the help they need to succeed in a higher-learning institution.

Table 1. Descriptive Statistics of Main Variables

	Mean	S.D.	Range
Demographics			
Age	20.35	2.08	18-36
Gender	1.79	0.42	1-2
MPQ Chronic Pain Measures			
Pain Rating Index (PRI)	27.02	15.67	0-78
Sensory Subscale	16.82	8.85	0-42
Affective Subscale	3.81	3.56	0-14
Evaluative Subscale	1.76	1.35	0-5
Misc. Subscale	4.64	3.88	0-17
Present Pain Index (PPI)	0.42	0.66	0-5
Number of Words Used	12.31	6.78	0-20
CES-D Depressed Mood Measures			
Depressed Mood	16.14	10.00	0-60
Depressed Subscale	4.68	4.30	0-21
Somatic Subscale	7.23	3.74	0-21
Lack of PA Subscale	3.12	2.77	0-12
Conflict Subscale	1.11	1.34	0-6
Other Measures			
Perceived Stress	18.52	6.91	0-40
Academic Performance			
GPA	3.27	0.42	0-4.00
Happiness with Grades	5.89	2.30	1-10
Grades Reflecting Ability	5.34	2.53	1-10

Table 2. Descriptive Statistics of MPQ Questions

		Freq.	Mean	S.D.
1	Temporal	166	3.17	1.84
2	Spatial	136	1.45	1.23
3	Punctate Pressure	137	1.90	1.66
4	Incisive Pressure	134	0.93	0.88
5	Constrictive Pressure	159	2.15	1.45
6	Traction Pressure	126	1.26	1.16
7	Thermal	107	0.88	1.01
8	Brightness	108	1.27	1.55
9	Dullness	176	2.88	1.61
10	Sensory Misc.	130	1.25	1.34
11	Tension	137	0.96	0.79
12	Automatic	102	0.65	0.70
13	Fear	93	0.68	0.83
14	Punishment	97	1.06	1.32
15	Affective Misc.	87	0.64	0.77
16	Evaluative	172	1.83	1.42
17	Sensory Misc.	110	1.95	1.28
18	Sensory Misc.	140	2.34	1.33
19	Sensory Misc.	79	2.72	1.38
20	Affective-Evaluative Misc.	140	3.11	1.43

Table 3. Bivariate Correlations Coefficients Between Pain, Depressed Mood and Academic Performance Variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. MPQ Pain Rating Index	—													
2. MPQ Sensory Subscale	.949**	—												
3. MPQ Affective Subscale	.880**	.760**	—											
4. MPQ Evaluative Subscale	.550**	.412**	.390**	—										
5. MPQ Miscellaneous Subscale	.873**	.711**	.765**	.577**	—									
6. CES-D Depressed Mood	.206**	.141*	.226**	.183**	.241**	—								
7. CES-D Depressed Subscale	.158*	.108	.178*	.115	.189**	.923**	—							
8. CES-D Somatic Subscale	.238**	.179*	.234**	.248**	.252**	.845**	.678**	—						
9. CES-D Lack of PA Subscale	.087	.029	.145*	.060	.133	.698**	.553**	.381**	—					
10. CES-D Conflict Subscale	.188**	.144*	.163*	.185**	.214**	.699**	.641**	.547**	.306**	—				
11. Perceived Stress	.121	.075	.122	.138*	.156*	.725**	.628**	.608**	.606**	.442**	—			
12. GPA	-.066	-.090	-.072	.011	.004	-.094	-.103	-.091	-.043	-.030	-.081	—		
13. Happiness with Grades	-.075	-.076	-.070	-.113	-.026	-.174*	-.109	-.201**	-.173*	-.033	-.265**	.706**	—	
14. Grades Reflecting Abilities	-.030	-.047	-.009	-.081	.022	-.156*	-.119	-.185**	-.086	-.089	-.190**	.574**	.681**	—

* $p < 0.05$, ** $p < 0.01$

Figure 1. Structural Equation Model

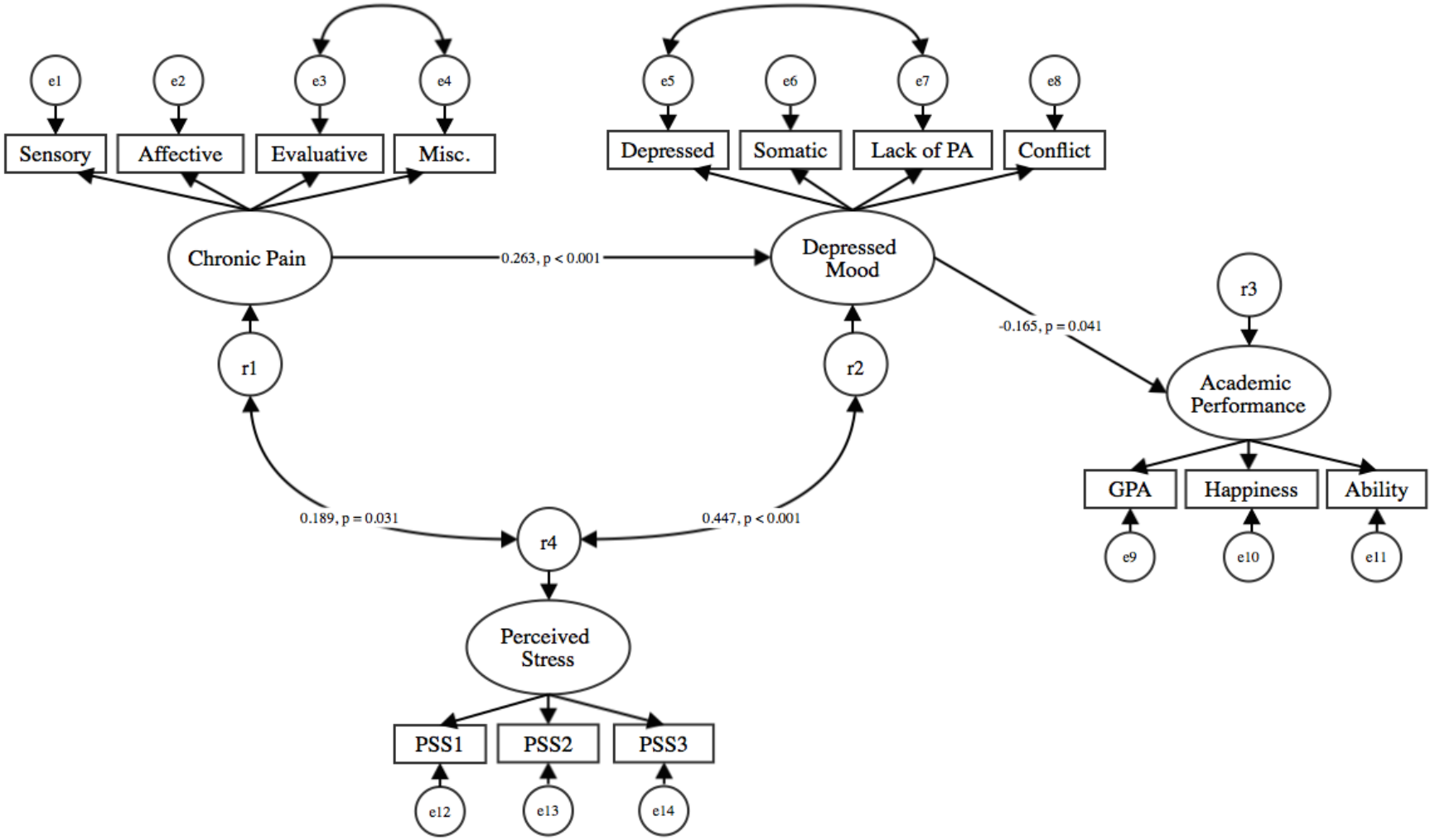


Table 4. Standardized Regression Estimates of the Structural Equation Model

			Estimate	S.E.	P
Depressed mood	<---	Chronic pain	0.26	0.04	***
Acad. Performance	<---	Depressed mood	-0.17	0.01	0.04
Sensory	<---	Chronic pain	0.84		
Affective	<---	Chronic pain	0.91	0.03	***
Evaluative	<---	Chronic pain	0.45	0.01	***
Miscellaneous	<---	Chronic pain	0.85	0.03	***
Depressed	<---	Depressed mood	0.85		
Somatic	<---	Depressed mood	0.80	0.07	***
Lack of PA	<---	Depressed mood	0.45	0.05	***
Conflict	<---	Depressed mood	0.72	0.03	***
GPA	<---	Acad. Performance	0.77		
Happiness	<---	Acad. Performance	0.91	0.58	***
Ability	<---	Acad. Performance	0.75	0.56	***
PSS1	<---	Perceived stress	0.61		
PSS2	<---	Perceived stress	0.77	0.16	***
PSS3	<---	Perceived stress	0.79	0.15	***
Perceived Stress	<-->	Depressed mood	1.84	0.43	***
Perceived Stress	<-->	Chronic pain	1.62	0.75	0.03

*** $p < 0.001$

APPENDIX A

MPQ Items in Order of Appearance in Survey

1. Does the pain you experience have a temporal feeling (rhythm)? If so, please choose which word describes it best.
   - Flickering
   - Quivering
   - Pulsing
   - Throbbing
   - Beating
   - Pounding

2. Does the pain you experience have a spatial feeling (movement)? If so, please choose which word describes it best.
   - Jumping
   - Flashing
   - Shooting

3. Does the pain you experience have punctuating pressure qualities? If so, please choose which word describes it best.
   - Pricking
   - Boring
   - Drilling
   - Stabbing
   - Lancinating

4. Does the pain you experience have incising pressure qualities? If so, please choose which word describes it best.
   - Sharp
   - Cutting
   - Lacerating

5. Does the pain you experience have constricting pressure qualities? If so, please choose which word describes it best.
   - Punching
   - Pressing
   - Gnawing
   - Cramping

6. Does the pain you experience have traction pressure qualities? If so, please choose which word describes it best.
    - Tugging
    - Pulling
    - Wrenching

7. Does the pain you experience have a thermal quality? If so, please choose which word describes it best.
    - Hot
    - Boring
    - Scalding
    - Searing

8. Does the pain you experience have a sharp quality? If so, please choose which word describes it best.
    - Tingling
    - Itchy
    - Smarting (irritating)
    - Stinging

9. Does the pain you experience have a dull quality? If so, please choose which word describes it best.
    - Dull
    - Sore
    - Hurting
    - Aching
    - Heavy

10. Do you feel any of the following sensations from the pain you experience? If so, please choose which word describes it best.
    - Tender
    - Taut
    - Rasping
    - Splitting

11. Does the pain you experience have a tension quality? If so, please choose which word describes it best.
    - Tiring
    - Exhausting

12. Is the pain you experience debilitating? If so, please choose which word describes it best.
    - Sickening
    - Suffocating

13. Is the pain you experience fearful? If so, please choose which word describes it best.
    - Fearful
    - Frightful
    - Terrifying

14. Do any of the following words describe your pain? If so, please choose which word describes it best.
    - Punishing
    - Grueling
    - Cruel
    - Vicious
    - Killing

15. Do either of the following affective-evaluative-sensory words describe the pain you experience? If so, please choose which word describes it best.
    - Wretched
    - Blinding

16. Is the pain you experience bothersome? If so, please choose which word describes it best.
    - Annoying
    - Troublesome
    - Miserable
    - Intense
    - Unbearable

17. Do you feel any of the following sensations from the pain you experience? If so, please choose which word describes it best.
    - Spreading
    - Radiating
    - Penetrating
    - Piercing

18. Do you feel any of the following sensations from the pain you experience? If so, please choose which word describes it best.
    - Tight
    - Numb
    - Drawing
    - Squeezing
    - Tearing

19. Do you feel any of the following sensations from the pain you experience? If so, please choose which word describes it best.
    - Cool
    - Cold
    - Freezing

20. Is your pain troublesome? If so, please choose which word describes it best.
    - Nagging
    - Nauseating
    - Agonizing
    - Dreadful
    - Torturing

APPENDIX B

CES-D Items in Order of Appearance in Survey

In the past week:

1. I was bothered by things that usually don't bother me.
2. I did not feel like eating; my appetite was poor.
3. I felt that I could not shake off the blues even with help from my family or friends.
4. I felt that I was just as good as other people.
5. I had trouble keeping my mind on what I was doing.
6. I felt depressed.
7. I felt that everything I did was an effort.
8. I felt hopeful about the future.
9. I thought my life have been a failure.
10. I felt fearful.
11. My sleep was restless.
12. I was happy.
13. I talked less than usual.
14. I felt lonely.
15. People were unfriendly.
16. I enjoyed life.
17. I had crying spells.
18. I felt sad.
19. I felt that people disliked me.
20. I could not get "going".

Possible Responses:

- Rarely or none (less than 1 day)
- Some of the time (1-2 days)
- A moderate amount of time (3-4 days)
- Most or all of the time (5-7) days
- Don't know/ prefer not to answer

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Academic Vita
SARA S. MANETTA

Permanent Address	(215) 932-4767	**Current Address**
1919 Westover Road	ssm5175@psu.edu	613 S. Allen Street, Unit 1
Yardley, PA 19067	sara.manetta@gmail.com	State College, PA 16801

EDUCATION

The Pennsylvania State University, University Park

College of Health and Human Development

Schreyer Honors College

Bachelors of Science in Biobehavioral Health, December 2014

Minors in Neuroscience and Biology

HONORS AND AWARDS

College Marshal, College of Health and Human Development, October 2014-December 2014

Bayard D. Kunkle Scholarship, August 2014-December 2014

Bucks County Alumni Association Scholarship, January 2014-December 2014

Schreyer Honors College Academic Excellence Scholarship, August 2010-December 2014

Schreyer Honors College, Pennsylvania State University, August 2010-December 2014

Dean's List, Pennsylvania State University, August 2010-December 2014

ASSOCIATION MEMBERSHIPS

Mortar Board Honor Society, April 2013-Present

Phi Beta Kappa Society, March 2013-Present

RESEARCH EXPERIENCE

Stress and Health Lab Research Assistant, January 2013-Present

Biobehavioral Health Department, Pennsylvania State University, University Park, PA

ESCAPE Project Data Analyst, May 2014-August 2014

Biobehavioral Health Department, Pennsylvania State University, University Park, PA

Hedges Evolutionary Biology Lab Research Assistant, May 2013-August 2013

Biology Department, Pennsylvania State University, University Park, PA

COMMUNITY INVOLVEMENT

University Health Services Clinic Intern, August 2013-Present

Pennsylvania State University, University Park, PA

Teach for America Ambassador, August 2013-May 2014

Pennsylvania State University, University Park, PA

Penn State Dance MaraTHON Morale Committee Member, October 2010-May 2014

Pennsylvania State University, University Park, PA

Biology Peer Leader, August 2013-December 2013

Biology Department, Pennsylvania State University, University Park, PA

Clinical Floor Volunteer, August 2012-May 2013

Mount Nittany Medical Center, State College, PA

Student Red Cross Club Member, 2010-2012

Pennsylvania State University, University Park, PA

CERTIFICATION

Emergency Medical Technician Certification, 2011-Present