FEARFUL PERSONALITY TYPE AND ITS ASSOCIATION WITH PHYSICAL STRENGTH

INTRODUCTION

The transition from high school to college is not easy. On the one hand, there is the excitement of starting a new life in a new place with new people, on the other hand, there is the anxiety of staying away from family, fear of change, and isolation. According to the study done on undergraduate students by American College Health Association, over 77% of student experience moderate to severe psychological distress. It also reported that 35% of students were diagnosed with depression and 27% had depression (S22 Undergrad Summary, 2022) Apart from anxiety and depression, college students are often time going through trauma, sleeping disorder, and eating disorders. The availability of mental health resources for college students is limited. Due to financial barriers and time commitments, the first resource they turn to is counsellors in college. Research conducted by Boston University; it was found that the rate of treatment of mental health conditions in the college student demographics has increased from 19% in 2007 to 34% in 2017. Likewise, the lifetime diagnosis rate increased from 22% to 36%. (Lipson et al.,2018) Since the trend of seeking help is increasing, it is important that the treatment process is multifaceted and effective. Thus, it is important to consider as many parameters as possible in the process of diagnosis and treatment.

Literature Gap

The treatment of mental health issues is isolated from physical health and well-being. Usually, the treatment process includes counselling and medications. However, often mental and physical health are interconnected, and one factor drastically affects the other. The bidirectionality can often be seen in two ways: *(i) manifestations,* body reacting physically to

mental states *(ii) medical management* challenging experience while seeking medical treatment for physical symptoms. (Spurrier et al.,2022)

Research Objective

In this study, we are going to investigate the correlation between fearful personality traits and grip strength between males and females. We want to explore if the observed differences in personality traits could be explained by the underlying difference in physical strength.

METHODS

For this study, five datasets were used with data collected from four different universities around the US. All five datasets come from undergraduate students of four colleges: UC Santa Barbara, Oklahoma State University, University of Texas, Austin, and Arizona State University. The dataset is comprised of self-reported HEXACO Emotionality scores and measures of grip strength.

HEXACO Emotionality Score

The HEXACO model of personality structure is a six-dimensional model of human personality developed by Aston and Lee. It includes Honesty-Humility (H), Emotionality (E), Extraversion (X), Agreeableness (A), Conscientiousness (C), and Openness to Experience (O). In this study, we collect the HEXACO Emotionality data, which has four facts Anxiety, Fearfulness, Dependence, and Sentimentality. (Lee and Ashton) Participants in samples 1 and 2 took the HEXACO IPIP test, where Anxiety, Fearfulness, and Sentimentality were keyed by 10 items, with 5 positively keyed and 5 negatively keyed. And each was measured on a scale of 1 to 7 ranging from strongly agree to strongly disagree. However, the Emotional Dependence score is not reverse-keyed. Participants in samples 3, 4, and 5 took the HEXACO-100 test, where each facet: Anxiety, Fearfulness, Sentimentality, and Emotional Dependence was keyed by four factors of which two were positive and two negatives.

Data Cleaning

The HEXACO test has responses to the following questions:

Samples 1-2, HEXACO IPIP items (7-point scale):

Anxiety, Positively Keyed:
e_anx_1: Often worry about things that turn out to be unimportant
e_anx_2: Worry about things
e_anx_3: Get stressed out easily
e_anx_4: Get upset by unpleasant thoughts that come into my mind
e_anx_5: Panic easily

Anxiety, Negatively Keyed:
e_anx_6: Rarely worry
e_anx_7: Rarely feel depressed
e_anx_8: Am not easily disturbed by events
e_anx_9: Remain calm under pressure
e_anx_10: Don't worry about things that have already happened

Sentimentality, Positively Keyed:

e_sen_1: Feel others' emotions
e_sen_2: Immediately feel sad when hearing of an unhappy event
e_sen_3: Cry during movies
e_sen_4: Am sensitive to the needs of others
e_sen_5: Am deeply moved by others' misfortunes

Sentimentality, Negatively Keyed:

e_sen_6: Rarely cry during sad movies
e_sen_7: Seldom feel weepy while reading the sad part of a story
e_sen_8: Am seldom bothered by the apparent suffering of strangers
e_sen_9: Don't understand people who get emotional
e_sen_10: Seldom get emotional

Emotional Dependence, Positively Keyed:

e_dep_1: Need reassurance
e_dep_2: Let myself be influenced by others
e_dep_3: Need the approval of others
e_dep_4: Need protection
e_dep_5: Often need help
e_dep_6: Show my sadness
e_dep_7: Suspect that my facial expressions give me away when I feel sad
e_dep_8: Seek support
e_dep_9: Can't do without the company of others
e_dep_10: Want to be liked

Fearfulness, Positively Keyed:

e_fear_1: Am a physical coward
e_fear_2: Begin to panic when there is danger
e_fear_3: Would fear walking in a high-crime part of a city
e_fear_4: Tremble in dangerous situations
e_fear_5: Would never go riding down a stretch of rapids in a canoe

Fearfulness, Negatively Keyed:

e_fear_6: Like to do frightening things
e_fear_7: Face danger confidently
e_fear_8: Love dangerous situations
e_fear_9: Would be good at rescuing people from a burning building
e_fear_10: Am willing to take risks

Samples 3-5, HEXACO-100 items (5-point scale):

hex_5: I would feel afraid if I had to travel in bad weather conditions.
hex_11: I sometimes can't help worrying about little things.
hex_17: When I suffer from a painful experience, I need someone to make me feel comfortable.
hex_23: I feel like crying when I see other people crying.
hex_29: I don't mind doing jobs that involve dangerous work.
hex_35: I worry a lot less than most people do.
hex_41: I can handle difficult situations without needing emotional support from anyone else.
hex_47: When someone I know well is unhappy, I can almost feel that person's pain myself.
hex_53: When it comes to physical danger, I am very fearful.
hex_59: I rarely, if ever, have trouble sleeping due to stress or anxiety.
hex_65: Whenever I feel worried about something, I want to share my concern with another person.
hex_71: I feel strong emotions when someone close to me is going away for a long time.
hex_77: Even in an emergency I wouldn't feel like panicking.
hex_83: I get very anxious when waiting to hear about an important decision.
hex_89: I rarely discuss my problems with other people.
hex_95: I remain unemotional even in situations where most people get very sentimental.

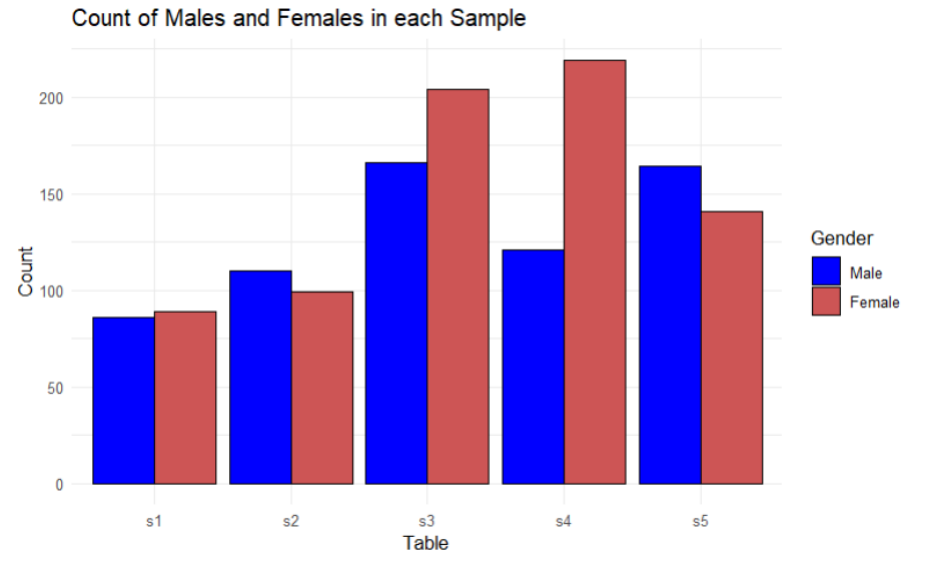
These datasets were cleaned by taking an average of each category and labelling them as positive and negative. Hence, the final dataset for samples 1 and 2 had columns for Anxiey_Positive, Anxiety_Negative, Fearfulness_Positive, Fearfulness_Negative, Sentimentality_Positive, Sentimentality_Negative, and Emotional_Dependence.

For samples 3,4 and 5 the score for each was calculated based on the scoring key for HEXACO-100, which is Fearfulness 5, 29R, 53, 77R Anxiety 11, 35R, 59R, 83 Dependence 17, 41R, 65, 89R Sentimentality 23, 47, 71, 95R. Here those marked as "R" are the score that indicates negative. (Manson, 2022)

RESULTS

Since the samples have data of students varying in age, sex, and ethnicity. First, the distribution of the data was explored.

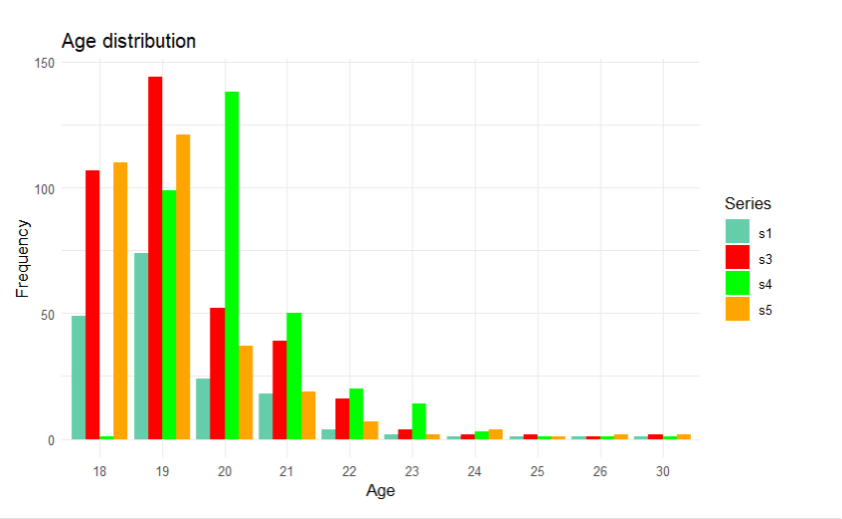
Sex Distribution



The sex distribution of the samples is uniform, except for Sample 3 and Sample 4, where the ratio of females is slightly higher.

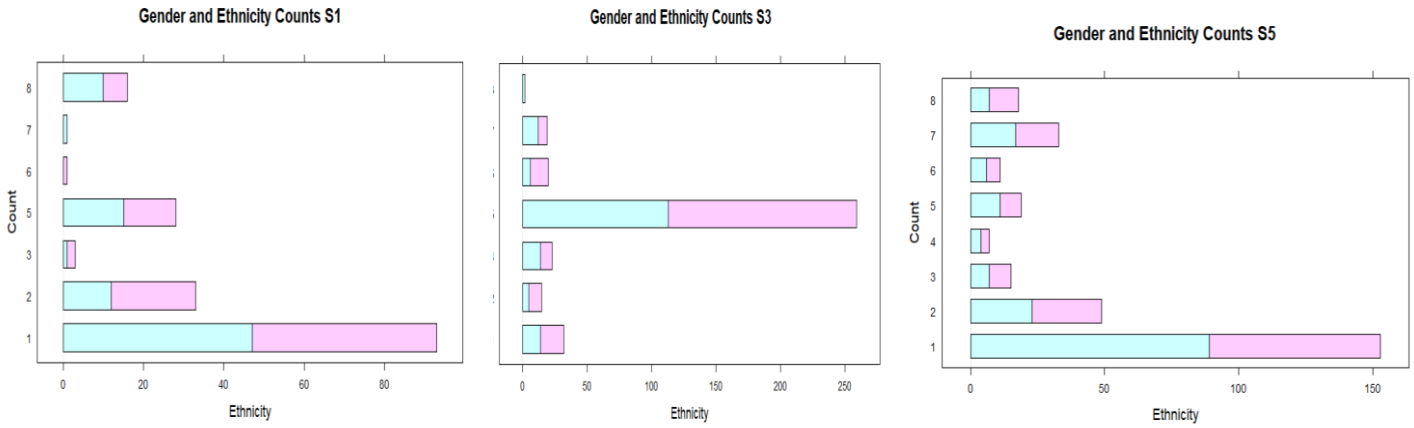
Age Distribution

The age data point of sample 2 is not collected. So, the age distribution of other datasets is shown below in the group plot.



As expected, the majority of participants are under 21, since this sample is based on undergraduate students the data is in line with what we can expect the age range to look like

Ethnicity



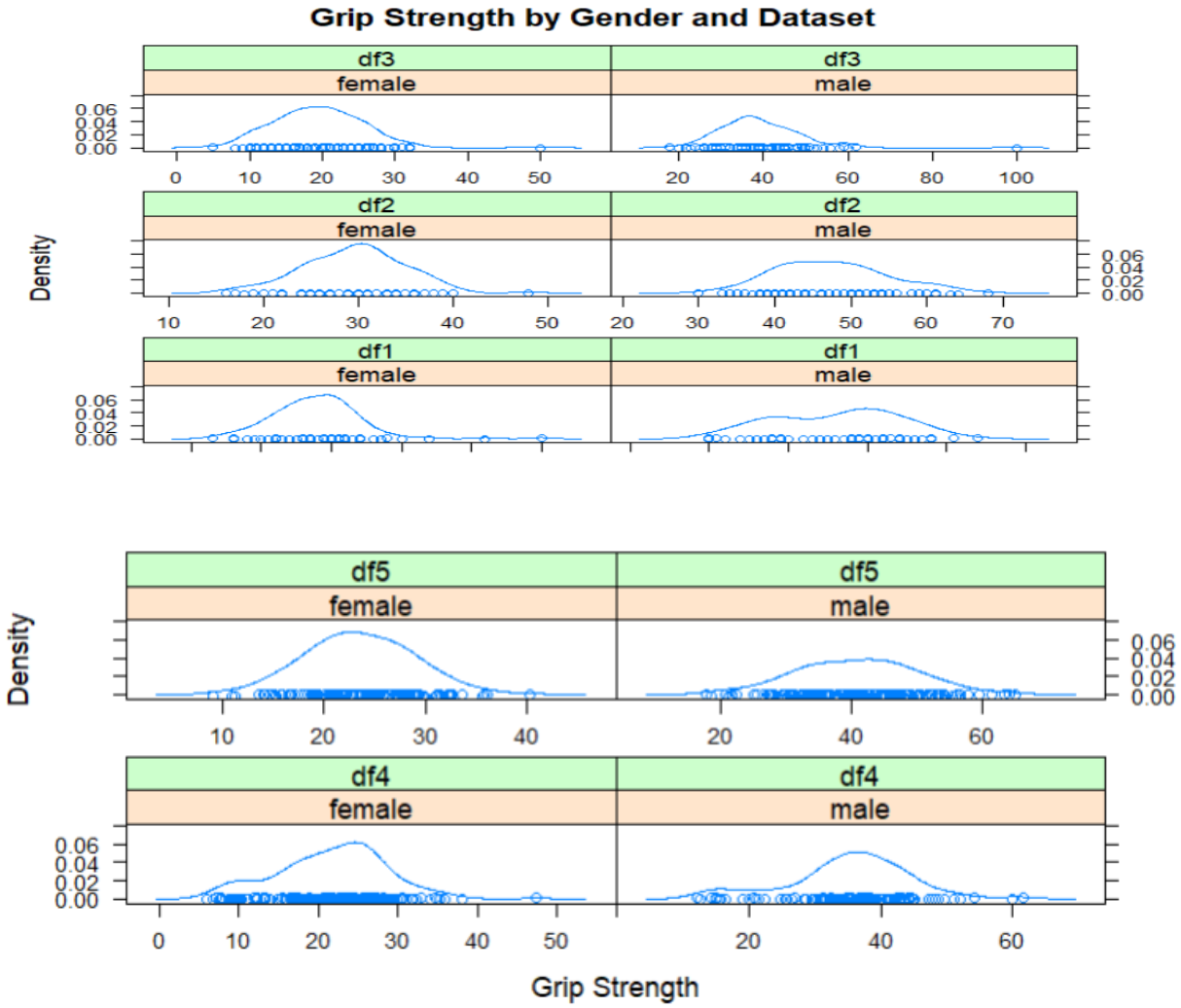
The ethnicity distribution of the samples was keyed in the following way:

- Sample 1: 1=White/Euro-American, 2=Hispanic/Latino, 3=Black/African-American, 5=Asian-American, 7=Pacific Islander, 8=Biracial, "Other," or Decline to State ethnicity,

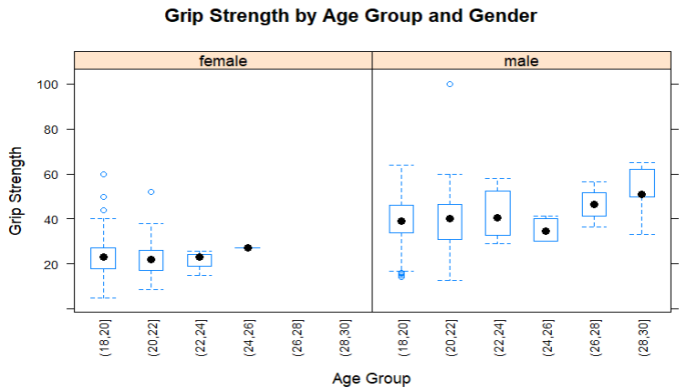
- Sample 3: 1=American Indian, 2=Asian-American, 4=Black/African-American, 5=White, 6=Hispanic/Latino, 7=Biracial, 8="Other" ethnicity,
- Sample 5: 1=White/Euro-American, 2=Hispanic/Latino, 3=Black/African-American, 4=Middle Eastern, 5-7=Asian-American, 8="Other" (Manson,2022)

Hence, we can infer from the graph that the data is heavily white dominated. However, the male and female ratio between each ethnicity is uniform.

Grip Strength Distribution



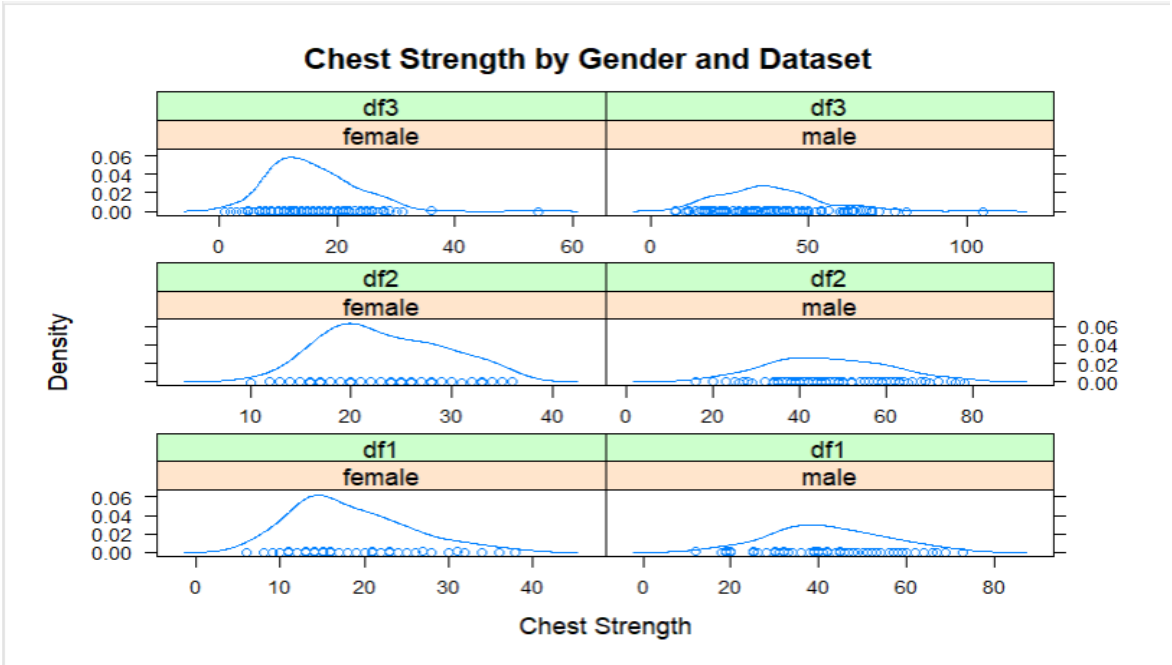
From the graph above, it is evident that the grip strength of males is higher than that of females. The grip strength has a normal distribution and across the dataset, the mean of the distribution is higher for males than that of females. This becomes further clear when we plot it against both sex and age.



Across all age groups, the average grip strength of males is higher than that of females.

Chest Strength

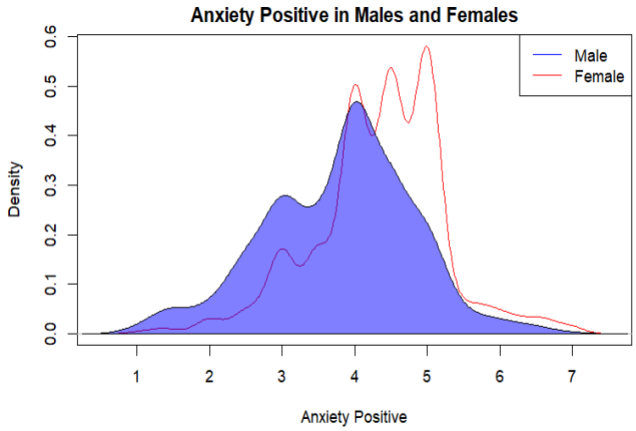
Sample 1,2 and 3 has data for chest strength. Comparing the chest strength of males and females we see a similar pattern like that in grip strength.

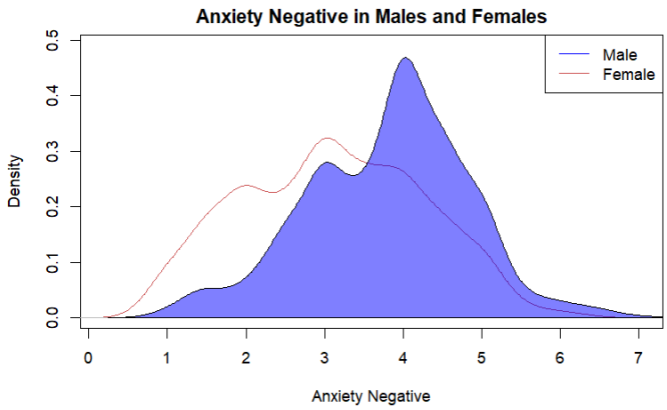


Comparison of Emotionality State between male and female

From the self-reported HEXACO Emotionality test, we have information in four facets: Anxiety, Sentimentality, Fearfulness, and Emotionality.

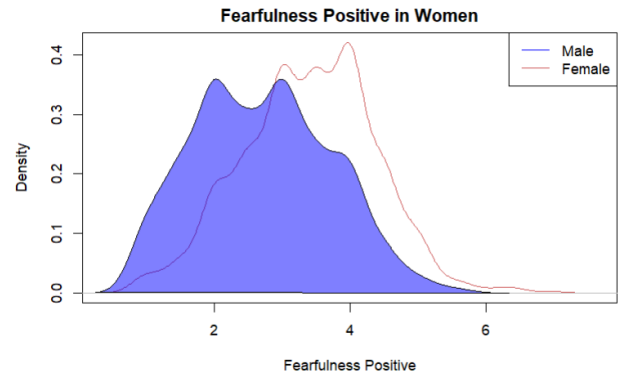
1. **Anxiety**

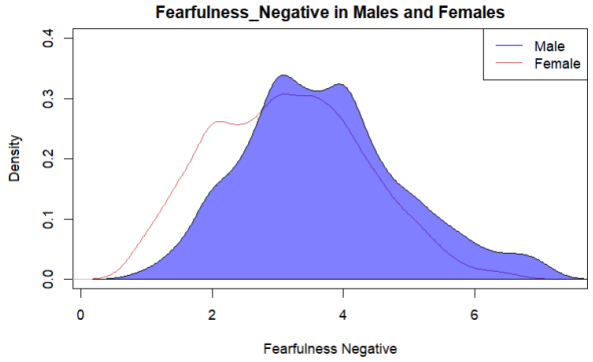




The anxiety scale measures the tendency of worrying in different contexts. A lower anxiety score means less stress even in difficult situations, whereas high scores tend to become stressed even with minor problems. (Lee and Ashton) The distribution of anxiety_positive in females is much higher than that in males. And the anxiety_negative score of men is much higher. Thus, implying that women are more likely to worry and be stressed.

2. **Fearfulness**

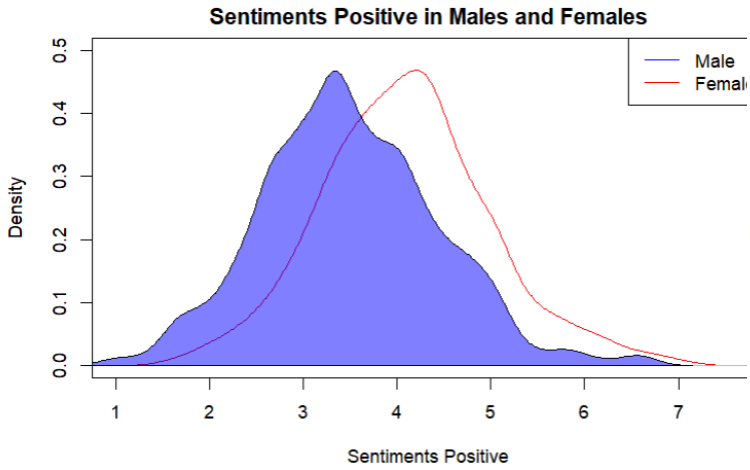


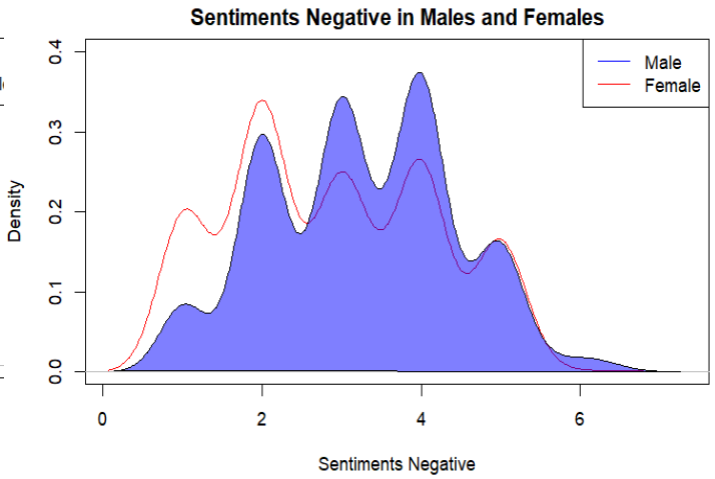


The fearfulness scale measures the tendency to experience fear. Higher fearfulness positive score is associated with a strong inclination to avoid physical pain or harm. Higher fearfulness negative score is associated with toughness, brave, and insensitivity to physical

pain. (Lee and Ashton) In the graph, it is evident that the fearfulness positive score is higher in females than that in males. However, in the fearfulness negative score, the distribution between males and females is slightly similar.

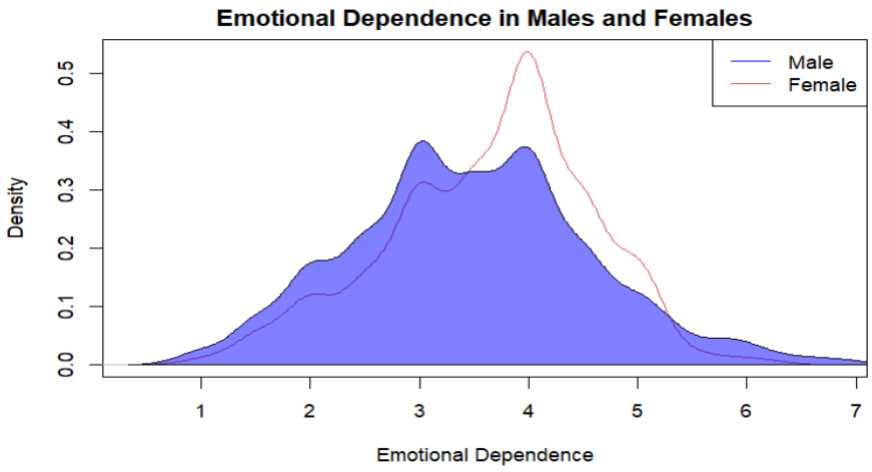
3. Sentimentality





The sentimentality scale measures the tendency to feel a strong emotional bond with others. A higher score in sentimentality positive is associated with feeling strong emotional attachment and empathy, whereas a higher sentimentality negative score is associated with feeling less emotions, and low concern about others feeling. We can see that the sentimentality positive score is higher in females than that in males. However, the sentimentality negative score has multiple peaks for both males and females and the data does not show any strong difference between genders.

4. Emotional Dependence

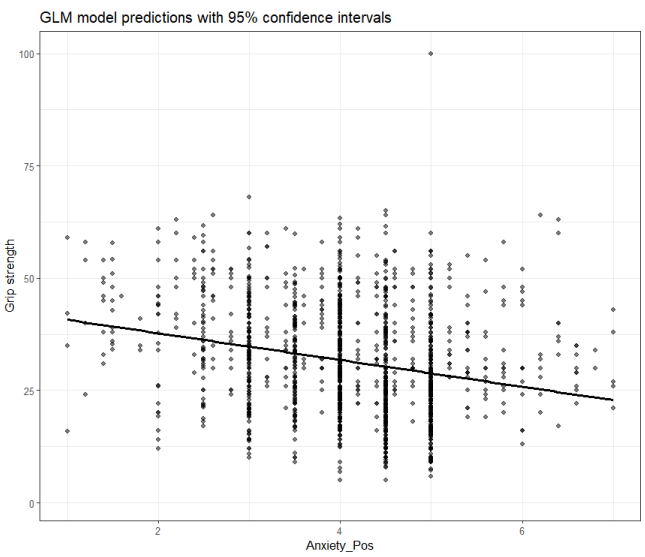


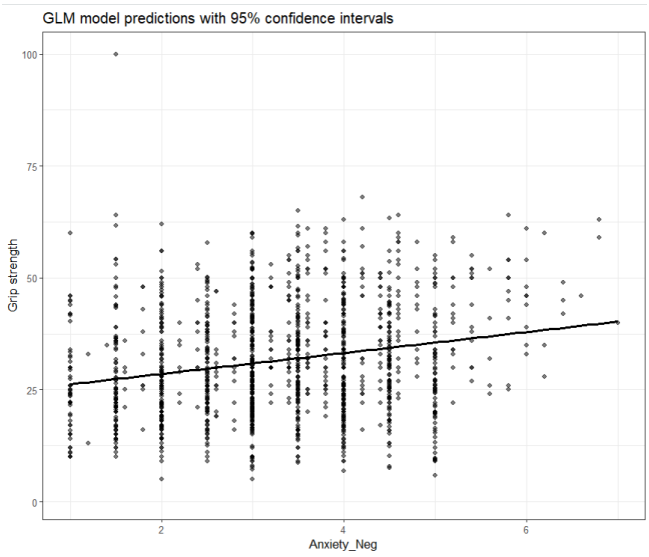
Unlike other measures, emotionality is not reverse-keyed so it is not divided into positive and negative. The emotional dependence scale measures one's need for emotional support. A higher score on this scale implies higher want to share difficulties with people who will provide them encouragement and comfort, whereas a lower score on this scale means they are self-assured and able to deal with problems/ situations without advice or help. From the graph, we can see that females are more inclined to higher scores on this scale than males.

Comparing Emotional State and Physical Strength

1. **Anxiety**

   Making a General Linear Model with the Anxiety Positive score and Grip strength, we can see that the higher the Anxiety Positive score, the lesser the grip strength, and the greater the Anxiety Negative score, the higher the grip strength.





A similar pattern was seen when grip strength was plotted against Fearfulness and Dependence. Hence a 3D linear model was made using Anxiety Positive, Fearfulness Positive, and Sentimentality Positive scores to model the relationship.

GAM Model to Predict the Grip Strength

Since this is a multi-variable model, Generalized Additive Models were used to explain the effect of each variable on the overall grip strength.

1. GAM models using the positively keyed traits

```
Family: gaussian
Link function: identity

Formula:
grip ~ s(Anxiety_Positive) + s(Fearfulness_Positive) +
s(Sentiments_Positive)

Parametric coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  31.5308     0.3037   103.8   <2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Approximate significance of smooth terms:
                         edf Ref.df      F p-value
s(Anxiety_Positive)     6.484  7.550  9.029  <2e-16 ***
s(Fearfulness_Positive) 2.129  2.727 41.876  <2e-16 ***
s(Sentiments_Positive)  3.121  3.945  1.019   0.347
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

R-sq.(adj) =  0.164   Deviance explained = 17.1%
GCV = 130.15  Scale est. = 128.96    n = 1398
```

2. GAM Model using the negatively keyed traits

```
Family: gaussian
Link function: identity

Formula:
grip ~ s(Anxiety_Negative) + s(Fearfulness_Negative) +
s(Sentiments_Negative)

Parametric coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  31.5308     0.3047   103.5   <2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Approximate significance of smooth terms:
                         edf Ref.df      F p-value
s(Anxiety_Negative)     3.900  4.853  2.246 0.06204 .
s(Fearfulness_Negative) 2.216  2.816 47.926 < 2e-16 ***
s(Sentiments_Negative)  3.985  4.804  4.120 0.00207 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

R-sq.(adj) =  0.159   Deviance explained = 16.5%
GCV =  130.8  Scale est. = 129.76    n = 1398
```

3. GAM model using all the HEXACO scores

```
Family: gaussian
Link function: identity

Formula:
grip ~ (Anxiety_Positive) + s(Fearfulness_Positive) +
s(Sentiments_Positive) +
    s(Anxiety_Negative) + s(Fearfulness_Negative) +
s(Sentiments_Negative)

Parametric coefficients:
                   Estimate Std. Error t value Pr(>|t|)
(Intercept)         36.3646     1.4899  24.407  < 2e-16 ***
Anxiety_Positive    -1.1813     0.3571  -3.308 0.000965 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Approximate significance of smooth terms:
                           edf Ref.df      F p-value
s(Fearfulness_Positive) 4.621  5.656 11.744 < 2e-16 ***
s(Sentiments_Positive)  3.447  4.330  3.424 0.00749 **
s(Anxiety_Negative)     1.000  1.000  1.265 0.26082
s(Fearfulness_Negative) 1.880  2.384 42.277 < 2e-16 ***
s(Sentiments_Negative)  3.905  4.717  3.875 0.00345 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

R-sq.(adj) =  0.238   Deviance explained = 24.6%
GCV = 119.04  Scale est. = 117.6     n = 1398
```

Comparing the performance of the models

Looking at the p-values of the parameters, in the first model, Anxiety_Positive and Fearfulness_Positive have a p-value < 0.05, which signifies their role in explaining the grip strength. Likewise in the second model. p-value of Fearfulness_Negative and Sentiment_Negative is less than 0.05. This also gets reflected when we make the third model with all the traits.

From the above statistical analysis, we can see that the third model with all the scores explains around 24.6% deviance. The deviance score for the first and second models is 17.1% and 16.5% respectively.

Comparing the AIC score of all three models we get:

Positive model Deviance: 178650.497309082

Positive model AIC: 10782.6400326794

Negative model Deviance: 179964.264441963

Negative model AIC: 10782.6400326794

Combined model Deviance: 162429.771771052

Combined model AIC: 10650.8295958229

For all models, two measures are provided: - deviance (measures difference between observed and predicted response) and AIC, (Akaike Information Criterion), measures of the quality of a statistical model, balancing the goodness of fit and the complexity of the model. Lower AIC indicates a better model. Lower deviance indicates a better fit of the model to the data. Comparing the results, we can see that the combined_model has lower deviance and AIC than other models, which indicates that it provides a better fit to the data and a better model overall.

CONCLUSION

Since physical strength also has a strong association with age and gender, the direct correlation of emotional state is limited. Our analysis does indicate the relation between emotionality state and grip strength. High neuroticism is associated with lower grip strength (Stephan et al.,2022) Neurotism accounts for the trait to experience negative effects like anxiety, emotional instability, and depression. (Widiger and Oltmanns, 2017) Since the probability of acquiring these negative emotions is higher among college students than others, it is important that physical strength is also taken into consideration while providing care and cure for mental health conditions. Thus, individuals with high Anxiety_Positive scores, and low Sentimentals_Positive score individuals may benefit from cognitive behavioral therapy focused on reducing depressive symptoms. It may also, in turn, have a positive effect on grip strength.

WORKS CITED

Lee, Ph, and Michael C. Ashton. “The HEXACO Personality Inventory-Revised.” *The HEXACO Personality Inventory-Revised*, http://hexaco.org/scaledescriptions. Accessed 7 May 2023.

Lipson, Sarah Ketchen, et al. “Increased Rates of Mental Health Service Utilization by U.S. College Students: 10-Year Population-Level Trends (2007–2017).” *Psychiatry Online*, 05 11 2018, https://ps.psychiatryonline.org/doi/full/10.1176/appi.ps.201800332#d4991033e1. Accessed 7 05 2023.

Manson, Joseph (2022), Sex differences in fearful personality traits are explained by facultative calibration to physical strength, *Dryad,* Dataset, https://doi.org/10.5068/D17D58

“S22 Undergrad Summary.” *American College Health Association*, https://www.acha.org/documents/ncha/NCHA-III_SPRING_2022_UNDERGRAD_REFERENCE_GROUP_EXECUTIVE_SUMMARY.pdf. Accessed 7 May 2023.

Spurrier, Georgia Faith, et al. “Physical symptoms as psychiatric manifestation in medical spaces: a qualitative study.” 15 07 2022, https://assets.researchsquare.com/files/rs-1840319/v1_covered.pdf?c=1657909212. Accessed 07 05 2023.

Stephan, Yannick, et al. “Five-factor model personality traits and grip strength: Meta-analysis of seven studies.” *Science Direct*, 09 2022, https://www.sciencedirect.com/science/article/pii/S002239992200246X. Accessed 07 05 2023.

Widiger, Thomas A., and Joshua R. Oltmanns. “Neuroticism is a fundamental domain of personality with enormous public health implications.” *NCBI*, 12 May 2017, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5428182/. Accessed 7 May 2023.