

Personalities at Risk: Drug Use & Personality Factors

The United States has an opioid problem. Since the late nineties, there has been an alarming increase in opioid use and abuse, forcing the Department of Health and Human Services to declare the opioid epidemic a public health emergency in 2017. Based on data from 2016 and 2017, it is estimated that each day there are more than more than 130 opioid-related deaths, 11.4 million people have misused prescription steroids, and 886,000 people have used heroin, 81,000 of which for the first time (often as a progression from opioid use). Many states, including Indiana, have started initiatives such as the 'Statewide Opioid Summit' to study and combat the epidemic, and universities are equally involved. In fact, IU has its own 'Responding to the Addictions Crisis Grand Challenge,' funding projects on all range of topics related to opioid addiction.

Statement of Goals

With one of the key worries of opioid use being the eventual transition from opioid to heroin use, it is interesting to explore how demographics and personality traits are related to heroin use. More specifically, I am interested in the follow questions:

- Which personality traits (if any) are correlated heroin use
- How heroin use varies based upon different demographics
- How these same demographics relate to other types of drug use
- How the relationship between personality traits and heroin use changes given different demographics

This being exploratory data analysis, no solutions are offered here. Instead, I hope that the identification of personality traits and demographic factors most correlated with heroin use could be used to help target specific intervention methods and people at higher risks of become addicted in the first place. With this information, a myriad of approaches to reducing heroin and opioid use could be taken. For example, perhaps if a person showed they were at a greater risk to use heroin based off of their personality traits and demographic factors, doctors could prescribe alternatives to traditional prescription opioids which might start the descent into heroin use. While the analysis presented here is relatively simple--PCA, conditional density estimate, Logistic Regression for binary response--the impact of such information could prove helpful, particularly if expanded upon in the future.

Description of Data

The data for this analysis comes from the "Drug consumption (quantified)" **dataset** (<https://data.world/uci/drug-consumption-quantified>), courtesy of the University of California Irvine, and initially owned by Elaine Fehrman, Vincent Egan, and Evgeny M. Mirkes of Rampton Hospital, the University of Nottingham, and the

University of Leicester respectively. The initial dataset contained 32 variables related to personality measurements, age, gender, education, country of residence, ethnicity, and drug use (both legal and illegal) for 1885 respondents.

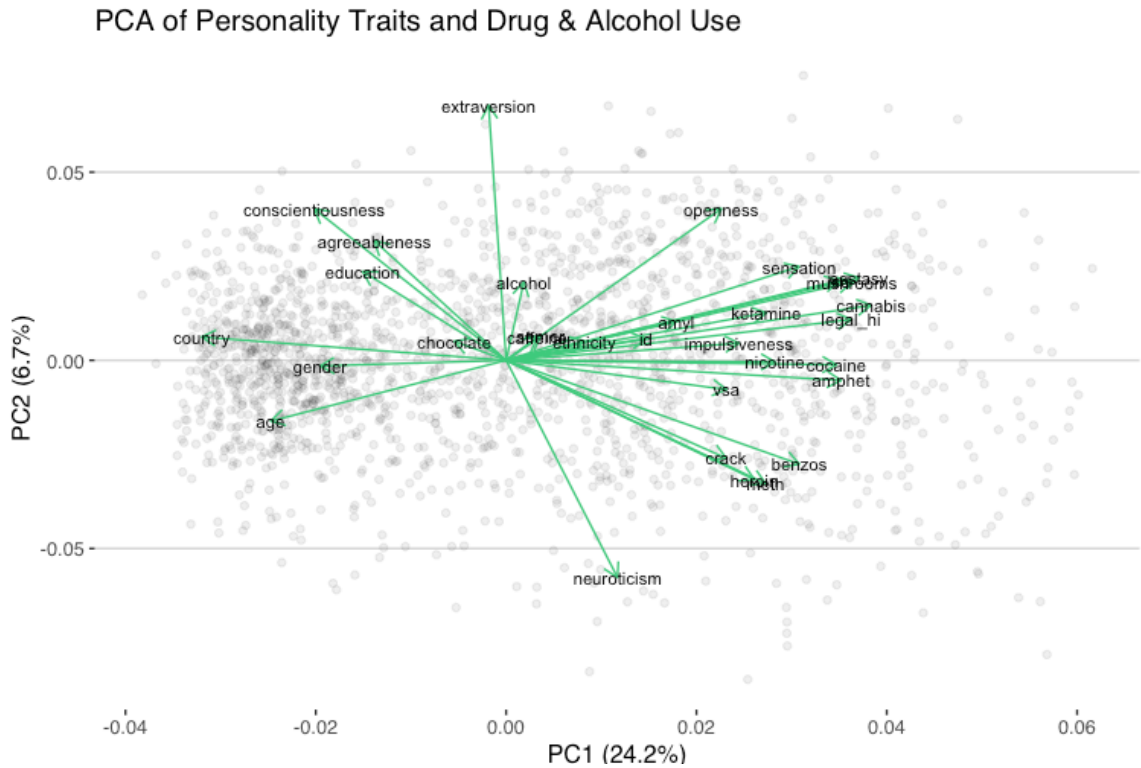


Figure 1

Based upon preliminary analysis composed of a PCA of the entire dataset (Figure 1) and a look more closely at correlation of demographic factors (See Appendix, Figure 1), I have narrowed down the variables analyzed here to 8. From the PCA, which it should be noted accounted for only 30% of the variation in the data, there were 3 personality traits associated with heroin use (neuroticism, impulsiveness, and sensation) as well as two other drugs which had extremely strong correlation with heroin use (meth and crack). From the examination of demographic data and heroin

use, gender and education had the strongest correlation (although for both it was still relatively weak). While some of these variables are categorical in nature, the dataset came pre-cleaned and quantified (values "can be considered as real-valued") resulting in odd-looking values for some variables. Descriptions of the 8 original variables are as follows:

- *gender* gender of participant 0.48246 = Female, -0.48246 = Male
- education*: level of education of participant. Values range from -2.413591 (having left school before 16 years) to 1.98437 (doctorate degree).
- *neuroticism*: stands for NEO-FFI-R Neuroticism score. People with high neurotic scores are emotionally reactive, those with lower scores tend to be more emotionally stable. The actual N-Score ranges from 12 to 60, here from -3.4636 to 3.27393.
- *impulsiveness*: impulsiveness as measured by BIS-11, or the Barratt Impulsiveness Scale. Here our values range from -2.55524 to 2.90161
- *sensation*: sensation seeking gas measured by Impulsive Sensation Seeking (ImpSS) scale. Values here range from -2.07848 to 1.92173
- *heroin, meth, crack*: All variables measure drug use. Response take the form of "Never Used", "Used More than a Decade Ago", "Used in Last Decade", "Used in Last Year", "Used in Last Month", "Used in Last Week" and "Used in Last Day" and are coded as "CL0", "CL1", "CL2", "CL3", "CL4", "CL5", and "CL6" respectively.
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In addition to the original variables, I also created binary variables for each of the drugs, with "Never Used" and "Used Over a Decade Ago" being classified as non-users and all other responses being classified as users (the delineation between users and non-users are taken from the original data set's description). I also ended up creating one variable to measure the combined scores of neuroticism, impulsiveness, and sensation.

Exploration

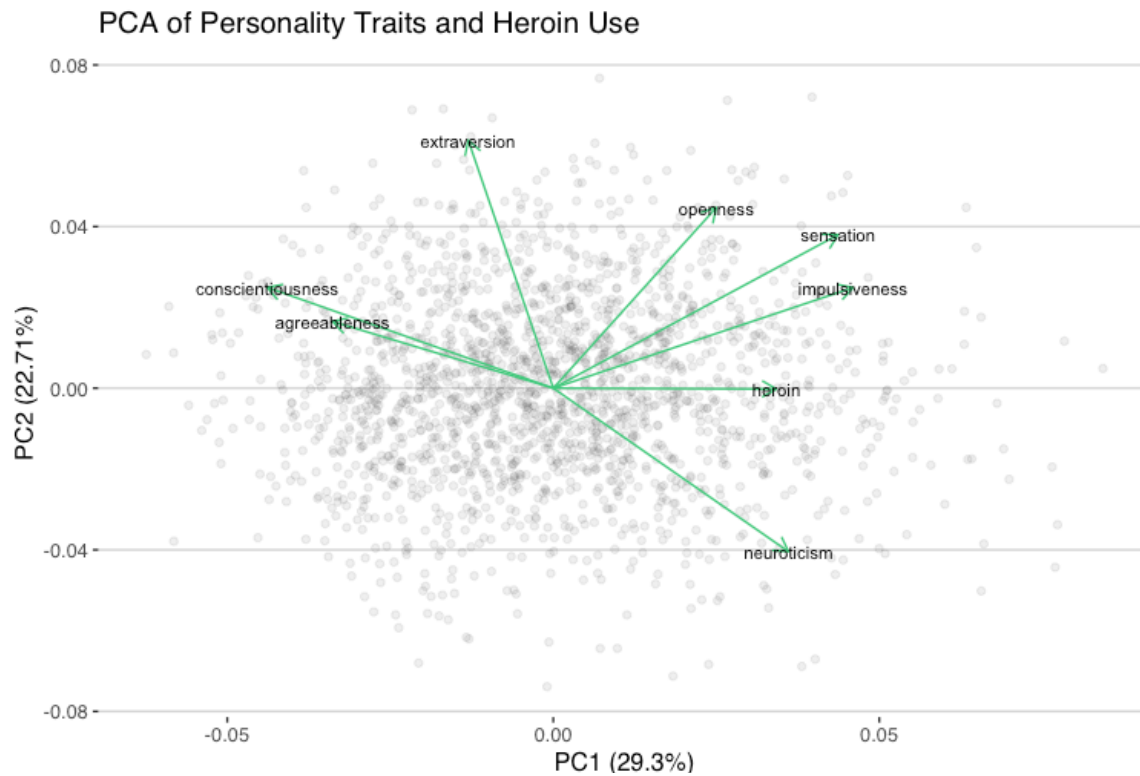


Figure 2

With the preliminary PCA of the entire dataset (Figure1) showing that openness, sensation, impulsiveness, and neuroticism are positively correlated with heroin, it seemed prudent to repeat the PCA , but only considering personality traits and heroin use as variables. While this analysis still only accounted for only 52.1% of total variation, by taking out the additional variables focusing only on personality traits and heroin use it is easier to see and interpret the correlation between heroin use and neuroticism, impulsiveness, and sensation (n+i+s).

To investigate this relationship more in depth, I plotted a conditional density estimate for heroin use based on a score for n+i+s. Figure 3 (below)clearly shows that

likelihood of heroin usage (and frequency of use) is strongly correlated to high scores on these personality indicators. One aspect of this graph that I didn't expect, is the total disappearance of 'Used in Last Day' for individuals with the highest combined impulsiveness + neuroticism + sensation score. While this could be related to a lack of data at this point, the large size of the original dataset makes me wonder if perhaps those who would have fallen into this category are the same group that overdose most likely. From this data there is no way to confirm or reject the theory (a dataset with overdose data would be necessary), however it would be an interesting area to explore further.

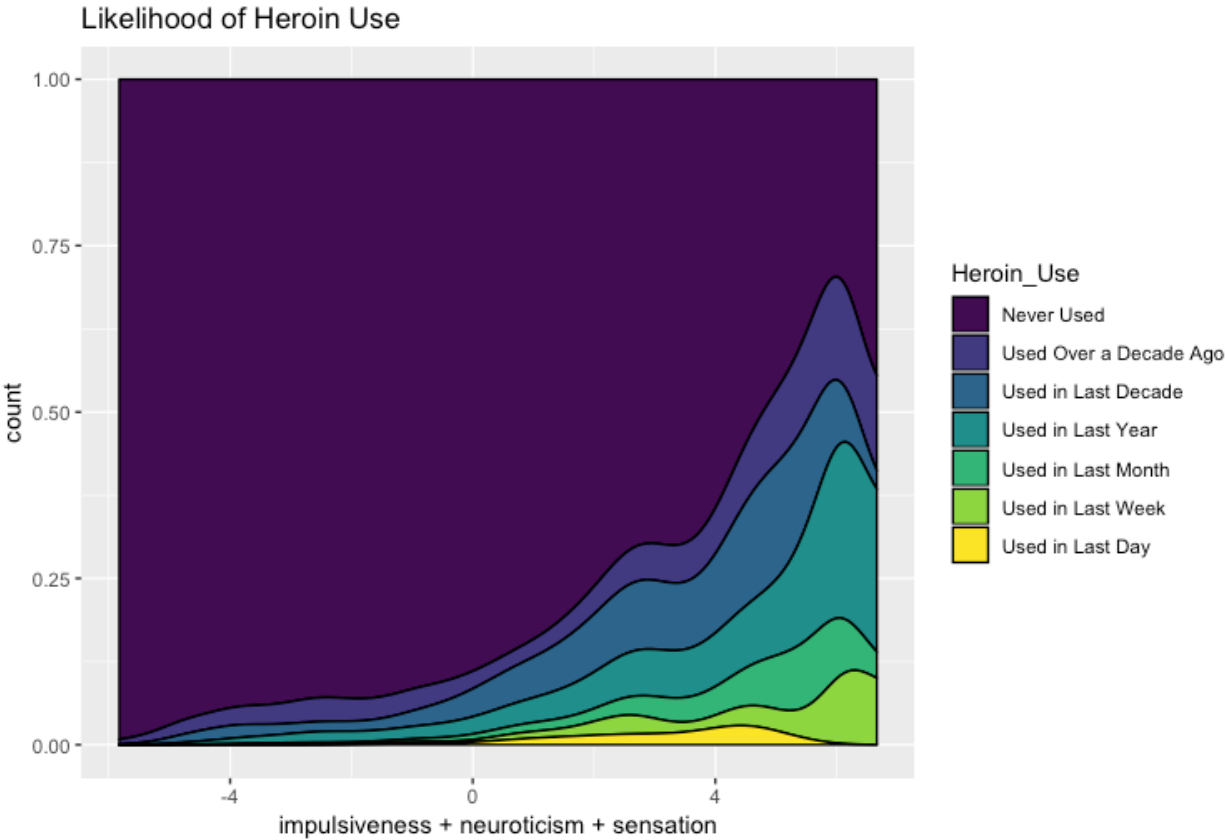


Figure 3

Having looked at heroin use and personality traits, let us examine how heroin and related drug use are associated with gender and education.

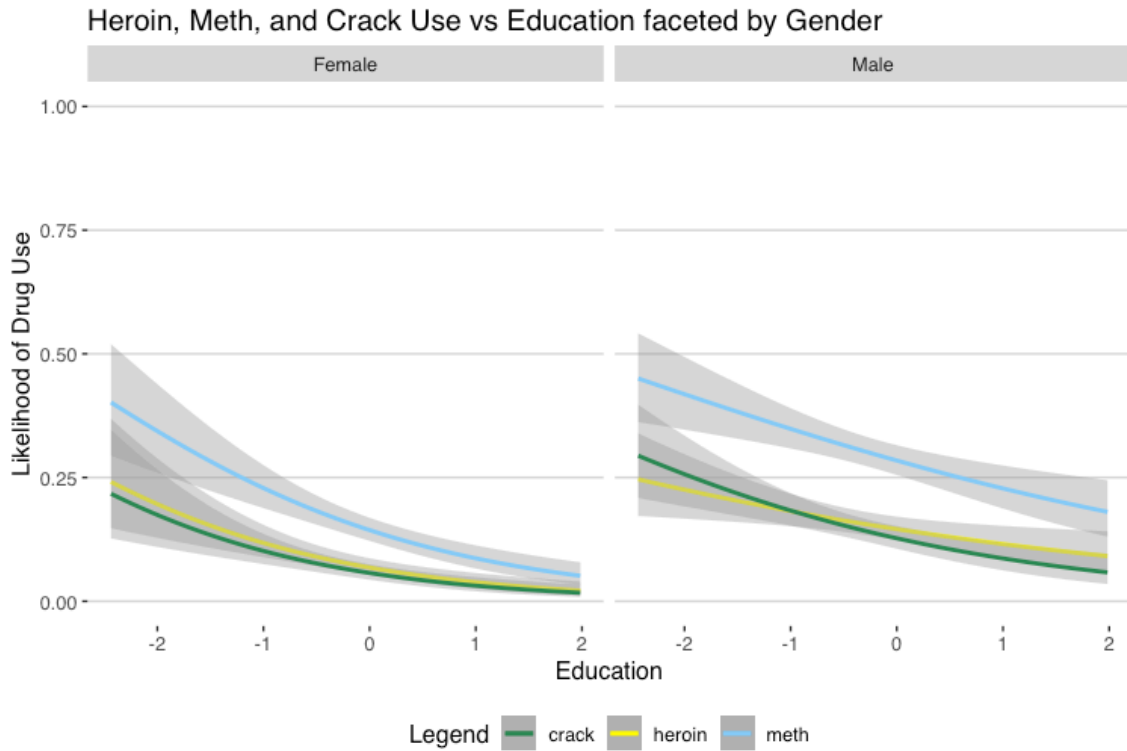


Figure 4

For heroin, crack and meth education is negatively correlated with drug use, as one would expect. However, this graph reveals some interesting differences between male and female drug use patterns. Among females, the most likely drug is consistent across all education levels: meth, then heroin, and finally crack. For males on the other hand, the likelihood of drug changes across education levels; at the lowest education level, the order is meth, crack, then heroin. At the highest education levels, this order switches, with the likelihood of which drug being used switching to meth, heroin, and then crack, a result of a comparatively small decrease in heroin use for males as

education level rises. This graph reveals that when considering education alone, likelihood of heroin use for males does not decrease as significantly as it does for other drugs. It also suggests that that education has a different impact on drug use (and particularly heroin use) for males and females.

Given the positive correlation between certain personality traits and increased heroin use as well as the negative correlation between education and heroin use, it makes sense to investigate if there is an interaction between certain personality traits and education. In other words, do personality traits impact peoples drug use differently at different education levels.

From Figure 5 (below) there does appear to be an interaction between personality traits and education. Looking at only the first two thirds of the fit line (after this point all education groups suffer from a lack of data, and in particular the 'Doctorate Degree' group), it appears that the slope is considerably less for groups with greater education, indicating that there is an interaction between education and personality traits in relation to heroin use. Beyond the slope, the intercept also appears to decrease slightly as education increases, the general negative correlation between education and drug use.

Given all this, I fit a model of heroin use based on the interaction between traits ($n+i+s$), education level, and gender. For this graph (Figure 6, below) I had to combine the educational groups into "Completed University" and "Does not have University

Degree;" left in the original groups, when separated by gender there were simply too few data points. Faceted based on these larger education groups (it should be noted that we still lack data at the upper ends of $n+i+s$ resulting in a questionable fit), we can see the interaction of these variables on heroin usage. As before, education is negatively correlated and the combined $n+i+s$ personality traits are strongly positively correlated with heroin use. This graph reveals, however, the impact that education has on males to counteract this $n+i+s$ effect. For males that do not have a university degree, heroin usage slopes steeply upwards with increased $n+i+s$ scores, as it does for females regardless of university completion. For males who have completed university however, the impact of the $n+i+s$ personality traits, while still present, seems to be severely diminished as the model is almost linear.

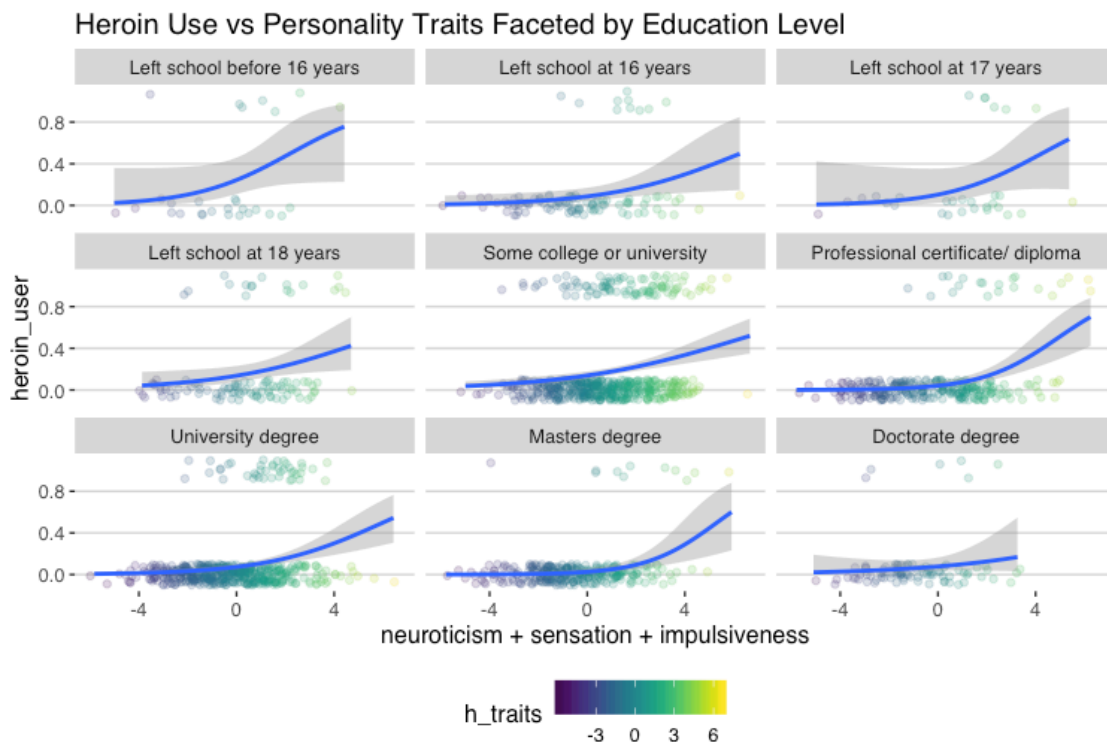


Figure 5

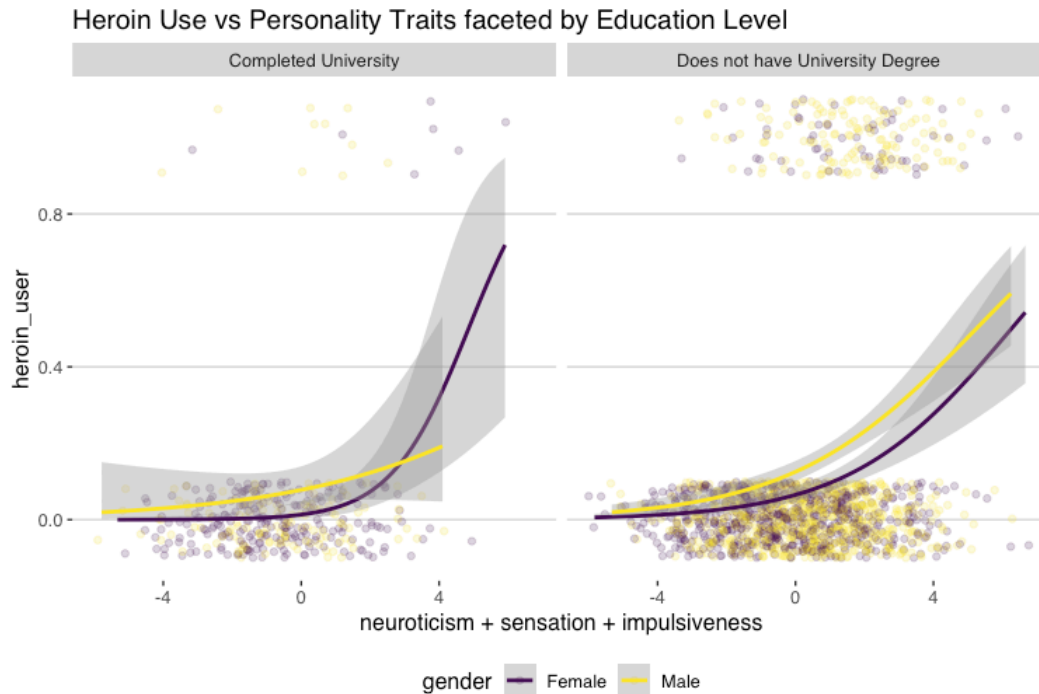


Figure 6

Limitations and Work Left

There is much, much more that could be explored with this dataset. Looking into why education seems to effect males with high n+s+i traits differently than females alone would require a much more extensive investigation; possible variables to include could be ethnicity and age. Perhaps men and women tend to go back to school at different ages and this is partially responsible, or perhaps in among different ethnicities gender plays a larger factor in attending college; neither of these possibilities is explored here. Opioid addiction, including heroin use, is an issue of critical importance in this country. While this analysis fails to even scratch the surface, hopefully it illuminates a few key areas – personality traits, education, and gender—that could be the focus for critical in-depth exploration, research, and treatment.

References

<https://www.hhs.gov/opioids/about-the-epidemic/index.html>

<https://www.in.gov/recovery/know-the-o/1150.htm>

<https://grandchallenges.iu.edu/addiction/index.html>

<https://www.123test.com/personality-neuroticism/>

<http://www.impulsivity.org/measurement/bis11>

Appendix

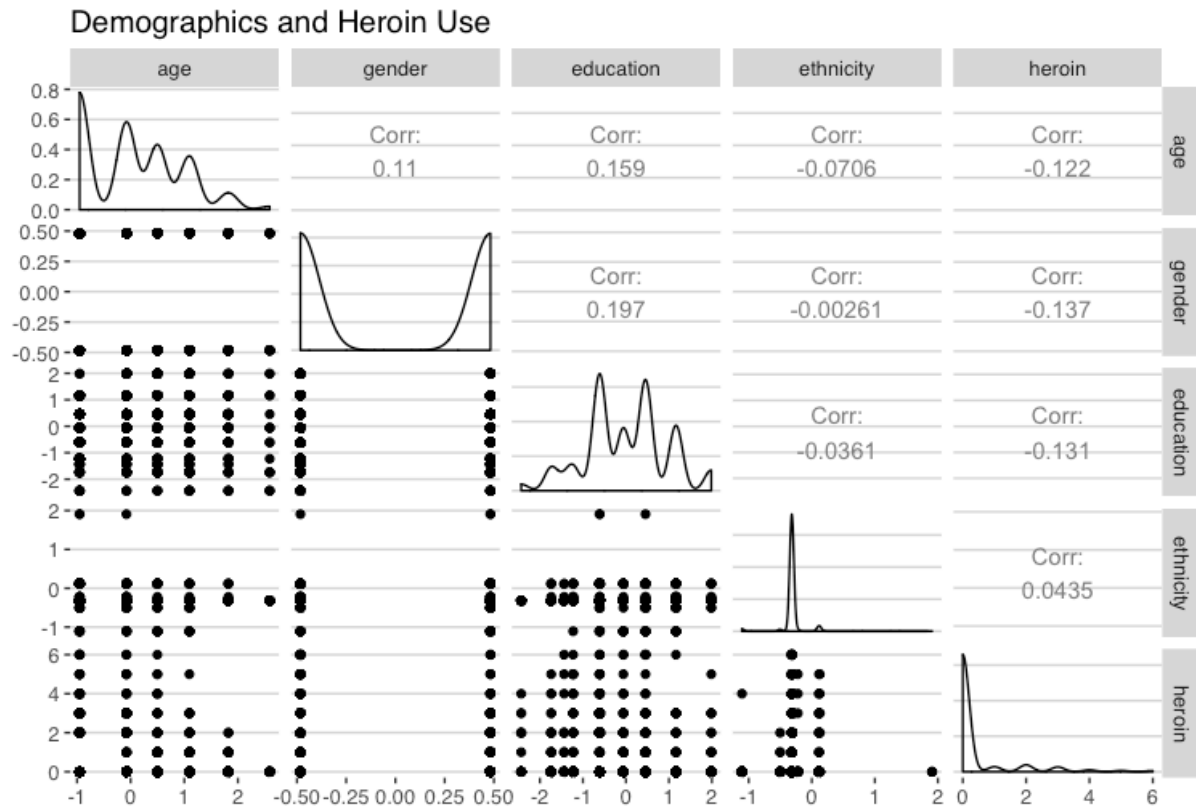


Figure 1