Dextroamphetamine: A Study of Individual Performance on the Most Common Mental Performance Enhancer

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Introduction

The modern world is becoming an increasingly competitive one. College acceptance rates are at an all time low. Workplace stress levels have risen nearly twenty percent in the last thirty years. The millennial unemployment rate sits at more than double the national average. In this environment, it is unsurprising that individuals looking to gain an advantage on the playing field are turning to self-medication in an attempt to artificially boost their capabilities.

One such medication is Adderall. A mixture composed primarily of dextroamphetamine salts usually prescribed as a treatment for Attention Deficit Hyperactivity Disorder (ADHD), Adderall has also been abused as a "smart pill" for decades. Non-prescription users without ADHD report that the drug helps them achieve a heightened level of focus, allowing them to absorb information faster, work at an accelerated pace, and maintain performance for longer periods of time.

As a result of these purported off-label benefits, Adderall (and other similar drug) abuse has been steadily on the rise. A study by Johns Hopkins University found that nonmedical use of Adderall increased by 60% between the years of 2006 and 2011. An article published in Psychology Today reports that the number of Adderall, or equivalent, prescriptions tripled between 2008 and 2012. Such rising rates of abuse are cause for significant concern. Along with the possibility of a potentially fatal overdose, long term Adderall abuse comes with side effects including aggressive behavior, paranoia, anxiety and seizures. Additionally, studies have shown that overuse of the "smart pill" can actually lead to memory loss in the long term.

With so many serious side effects, it is important to examine the root cause off-label use of stimulants such as Adderall: the belief that they will increase productivity and cognitive ability. The purpose of this study is to examine these anecdotal benefits of Adderall to test if there is any validity to the claims. If there is, the drug may, under controlled circumstances, have additional prescription uses. If there is not, then experimental evidence showing the ineffectiveness of stimulants for boosting performance may help curb the rising rates of their abuse.

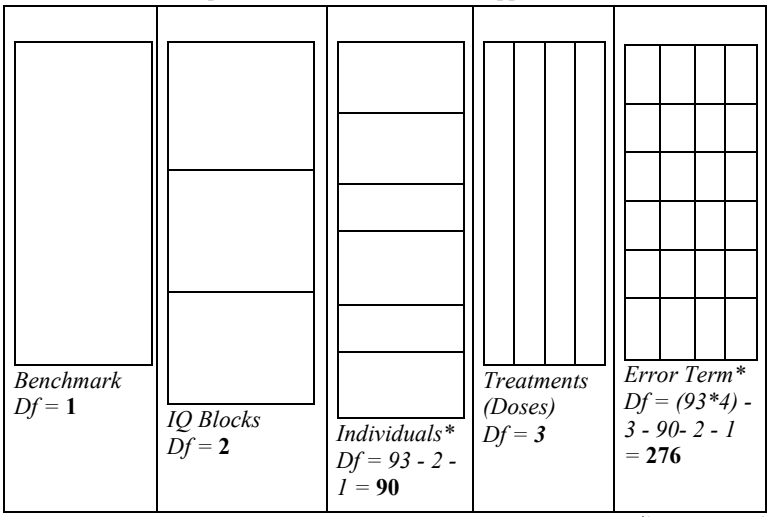
Methods

Participants

We will select islanders from the simulated Island program. We will determine the sample size using the G*Power applet with a power setting of 0.8 for 3 groups and 4 treatments. The individuals will be selected without regard for location, gender, or age, with the assumption that these factors have a limited effect in intelligence.

Design

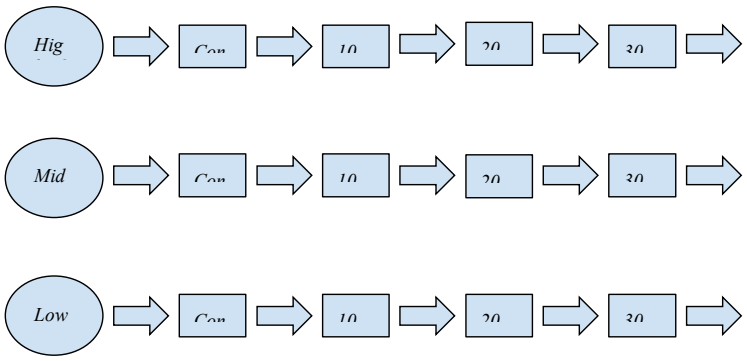
To study the effect of dextroamphetamine, we will be utilizing a repeated measures experimental design. Once the islanders have been selected, their respective IQs will serve as blocks. The dextroamphetamine treatments will be applied to each block in succession.



*boxes not to scale

Each individual will undergo successive treatments, allowing one day to pass between each larger dosage for recovery. We will seek to measure the effect of drug dose on the resulting cognitive ability of the subjects, as well as the interaction between the effects of dextroamphetamine and baseline IQ scores. We will also compare with a placebo treatment.

Comment [1]: Lets add an interaction to this factor diagram to make it a true repeated measures design



Apparatus/Instruments

A study of this magnitude with this design requires a few different types of materials. First, we will need to have IQ tests for the subjects to take in order to find an initial placement for the subjects. The IQ test will serve as the benchmark for how "intelligent" the subjects included in our experiment are. In addition, we would have multiple doses of dextroamphetamine (known as Adderall) ranging from 10 mg, 20 mg and 30 mg as well as a sugar pill to add a control to the experiment. Another material used would be the "difficult mental arithmetic" to observe how well the subjects perform on a specific mental exam based on their differing IQ levels and dosage of dextroamphetamine. The IQ test itself is reliable because most subjects will score the same or very close to the same score each time the test is taken in a relatively short period of time. Although the IQ test is not a valid representation of one's overall capabilities, it serves as a valid test when measuring a subject's short-term memory, analytical thinking, mathematical ability and spatial recognition. The difficult mental arithmetic test is reliable and valid in terms of measuring the subject's mental problem solving, as well as testing ability of performing calculations with whole numbers and fractions. The use of the IQ test helps indicate where the subjects initially stand with their mental performance. Then when increasing each subject's doses of dextroamphetamine, it becomes possible to examine if their scores on the "difficult mental arithmetic" exam will increase, stay the same, or possibly decrease. Materials may be obtained online with the IQ test, along with the "difficult mental arithmetic". The dextroamphetamine will be bought for use as a means of experimentation from a pharmacy.

Procedure

To start the experiment, we would select islanders who agreed to participate in our study from different cities. After finding the appropriate sample size, we would then split the subjects evenly into three different groups. The method we would use to split the groups up would be by giving them an IQ test and sorting them by their scores ranging from low, average, and high. We would then proceed to give each subject an initial diagnostic test to measure their mental ability based on the "difficult mental arithmetic" test. Once we have each subject's baseline scores, we would give the first dosage of dextroamphetamine consisting of 10 mg, wait about 30 minutes for the tablet to kick in, and have each subject retake the "difficult mental arithmetic" exam. After recording their scores for this dosage, we repeat the same process on the same subjects with 20 mg of dextroamphetamine and then 30 mg of dextroamphetamine following that, all spread out between two days of recovery for each dosage increase. Once each subject's scores have been measured for each dosage of dextroamphetamine, we then compare the results to see if, in reality, there is a difference in their arithmetic scores with the help of the performance enhancer and if that difference is more prevalent in those with lower, average, or high IQ's.

Data Analysis

For the data analysis part, our team will input all of our data first into RStudio. After sorting and transformation of the data, we will come up with some models which will help analyze the data.

Using the G*Power software to determine the needed sample size for the analysis, we notice that the sample size varies a lot with different effect size. After carefully examining the relationship between the effect size and the sample size, we perform tests on 31 individuals per each IQ level block to randomize the result for each variable. The associated alpha would be 0.05 and power set to 0.80.

We will start by creating the linear models for our variables in R studio. By plotting graphs with respect to our variables, we will look at the relationships between the residuals and variances to ensure some fundamental assumptions like the normality of residuals and constant variances. After checking the validity of our models, we will analyze our collected data to see if there are any differences in arithmetic exam scores based on dosage of dextroamphetamine given and the subject's initial baseline arithmetic and IQ test scores.

Analysis of variance (ANOVA) will be performed several times to determine if there exists a statistically significant explanation of the observed variation between subjects' exam scores after different doses of dextroamphetamine.

We will then look at the sum of squares, the mean sum of squares, degrees of freedom, corresponding F values, and the p-values for our predictors and other variables. The ANOVA test will let us draw a conclusion on whether we can see a difference in exam results for our subjects when consuming different doses of dextroamphetamine. As for the visualization purpose, we convert our results into boxplots and Tableau by using Tukey HSD method with colors.