Methods of a Stimulant Depressant Effects Suppression Study

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1 Preface

This project started as a semester project for my MEi:CogSci studies. It combines neuroscience, cognitive psychology and applied computer science into a multidisciplinary empiric study. In this document the aim of the project is briefly introduced, and methods of the experiment are discussed in depth. The whole study will be presented at the MEi:CogSci Conference 2020.

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2 Introduction

Stimulants and depressants are classes of drugs that accordingly increase and decrease central nervous system activity. With seemingly opposite effects a question arises of what the combined effects are. This question is popular even in general public in recreational drug users. Because of feel good effects of stimulants they're often attributed almost magical powers which shows e.g. in popular culture references (lyrics of songs, movies and TV shows, social media posts,...). This image can be particularly dangerous since it leads people to mix substances abuse of which is dangerous on its own. The biological aspects of mixing substances from these classes were studied for some of their combinations but surprisingly the cognitive aspects remain mostly unknown to this date.

To conduct this experiment, we had to pick particular substances and what aspect of cognition we wanted to focus on.

For depressants the choice was clear. Alcohol is a very popular recreational drug with currently almost one third of the world population being drinkers (Griswold et al., 2018). Another attributes that make alcohol suitable is its strength and well-known major effects on cognition.

The choice of a stimulant was a bit more difficult. There are some stimulants that are legal in most of the countries. These include caffeine and nicotine. However, none of these stimulants is suitable for this experiment since they're not particularly strong and wouldn't satisfy the motivation of this study. This means we had to move to illicit or prescription substances. We ended up choosing cocaine. It's currently the most popular stimulant and the second most popular illicit drug after marijuana (European Union & European Monitoring Centre for Drugs and Drug Addiction, 2019). It's often used recreationally and in settings that are tempting for alcohol use as well. It also satisfies the motivation since it's very prominent in the popular culture.

The last piece to choose was the aspect of cognition we were going to focus on. The choice ended up being fine motor task performance. Motor task performance was chosen because it can be relatively easily objectively measured. Focus on fine motor tasks was chosen because fine motor skills are easier to disrupt. In particular we have chosen keyboard typing as a representant of the fine motor skills. Keyboard typing is suitable because performance of its execution can be easily measured and it's a very common skill that a lot of people practice daily.

To confirm that these choices make for a reasonable hypothesis we have confirmed that these substances affect the fine motor task performance on their own. The fact that alcohol alone negatively affects motor task performance is well known but it was also confirmed by Connors & Maisto (1980). According to Higgins et al. (1990) cocaine on its own improved fine motor task performance by 4% while study by Stillman et al. (1993) also confirms an improvement and hypothesizes it might be caused by motor improvement:

> "*Thus, in the cocaine condition, improvement in speed occurred with a relative decrement in attention. This suggests that the quickening of reaction time after cocaine is not mediated through an attentional mechanism but through enhancement of a different stage of responding, perhaps a motor or noncognitive one, and most likely a stage of response affected by fatigue.*" (Stillman et al., 1993)

A further confirmation of this combination being of interest was raised by Foltin & Fischman (1988). The medical aspects were studied to a reasonable extent since but the cognitive were not. A popularity of this combination of drugs was also confirmed by Di Sclafani et al. (2002).

3 Methodology

We've come up with two versions of this experiment. The first version was designed for ideal conditions without considering any real-world limitations. The second version was created by carefully simplifying the first version to an extent necessary to make this experiment conductible in our conditions.

In this section both versions are described, and the differences explained. The main difference is that normally this experiment would be conducted in a lab with all of the substances administered by the research team. That isn't possible for us in Slovakia because of complicated approvals which we almost certainly wouldn't be able to get, the high cost and time requirements. Because of this the participants of the second version of the experiment are volunteers that already recreationally use cocaine and were found using anonymous online forums (e.g. reddit). They do the experiment by following instructions online and self-report the results. This isn't ideal but cocaine studies were previously conducted in this way and they have proven to have acceptable reliability (Rahman & Clarke, 2005).

The complete online version of the experiment is available here https://forms.gle/hsj6PfcFVZR9xzHC8.

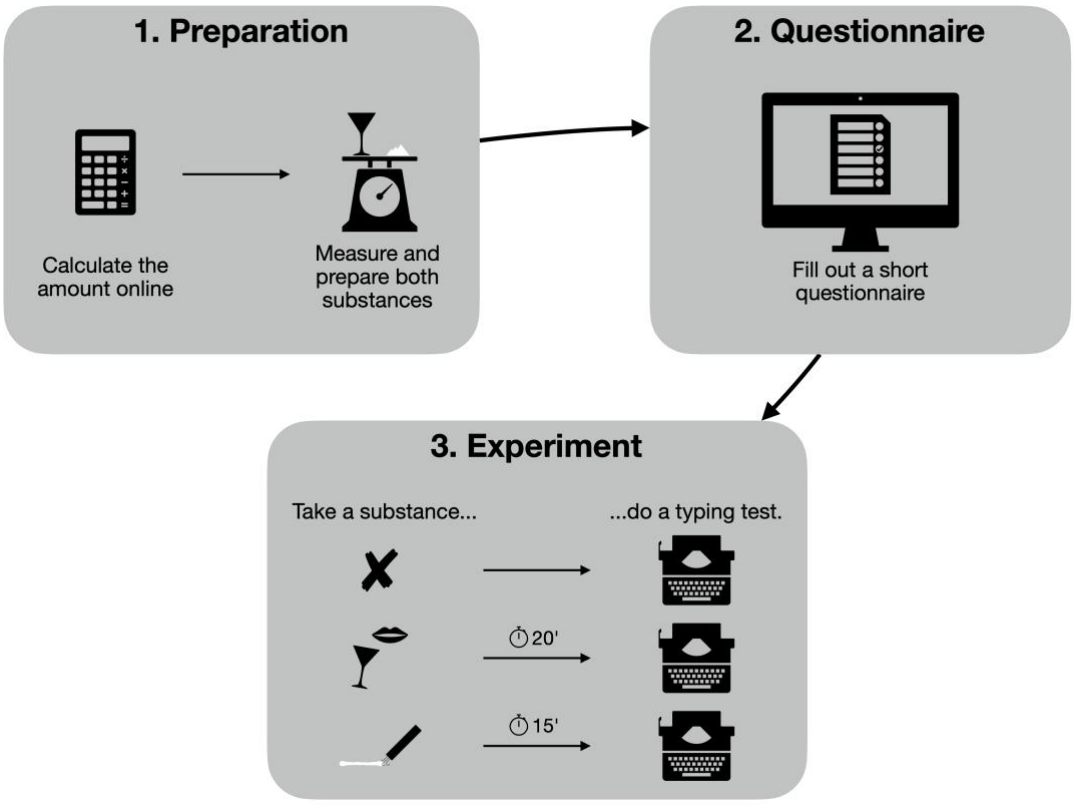

Figure 1: A graphical representation of the experiment design.

3.1 Participants

In the ideal version at least 20 participants are needed. An even split between men and women is ensured. The participants are in a productive age with age range limited based on the number of participants (if there were only 20 participants 20 to 40 years old age limit would be needed for accuracy, in case of more participant the age differences could be larger). Advanced computer experience is needed to eliminate people not capable of touch typing. Touch typing is typing without having to look at the keyboard. It plays an important role in this experiment since alcohol decreases hand-eye coordination. That means that alcohol would affect performance of non-touch typists more than of touch typists which is an error that is unnecessarily hard to correct (or maybe it would even induce a completely new condition). The last requirement is that the participant has to be a recreational cocaine user and an occasional drinker. Recreational cocaine user was defined by Soar et al. (2012) as a person that uses at most 4 grams of cocaine per month and uses cocaine at most 10 times a month.

For the online version the number of participants needed is higher but since this is a preliminary study, we didn't set any minimal number of participants. The demographical split is monitored but it's not enforced in any way since we don't know the number of participants in advance. Basic computer skills are implicit from the recruitment method. Other than that, there are no changes to the ideal design.

3.2 General procedure

The participants have to abstain from any psychoactive drug use for at least 48 hours before the experiment which will be confirmed by blood alcohol content (BAC) and benzoylecgonine in urine tests. The last solid food cannot be eaten later than two hours before the experiment starts. Caffeine and nicotine are permitted for the whole time, even during the experiment, in doses and frequencies the participant is used to, but are monitored and considered in the evaluation. All of the sessions will be done at approximately the same time of the day to prevent tiredness from affecting the results. After taking the substance and before starting the keyboard typing performance measurement, videos will be played to the participants to act as a timer, keep the participants entertained and give time to the substances to take on full effect. All participants will do the experiment in two orders of the conditions (sober - alcohol - cocaine; sober - cocaine - alcohol) with a 14 days safety break in between. Before starting the experiment, an informed consent is obtained.

In the online version the whole experiment is done by participants following the instructions online and self-reporting the results. The drug abstinence isn't enforced but is self-reported as well along with food consumption and tiredness. The participants also report their subjective sensitivity to alcohol and cocaine. Informed consent is obtained as a part of the screening process.

3.3 Alcohol administration

Based on the research in this domain we've chosen 0.6 grams of pure alcohol per body weight kilogram which is a moderate to heavy dose. In some studies, a BAC measurement is taken afterwards, and additional alcohol is served if certain BAC threshold isn't met. This doesn't seem to be necessary nor have any major benefits and was therefore left out. The alcohol is administered in a form of vodka and served along with three times the amount of water. The alcoholic beverage is drunk over a course of 15 minutes. Additional 30 minutes pause is than given for the alcohol effects to fully take place.

In the online version the amount of pure alcohol doesn't change. The beverage choice is left to the participants, but they're recommended to choose strongest and purest option available to them. The calculation of the amount is done using a purpose-made calculator that is available at the following URLs: http://calc.unaux.com/ (an anonymous webhosting - a public version) and http://davinci.fmph.uniba.sk/~kovac254/calc/calculator.php (a university server - version only meant for development and not for public sharing, since the university hasn't agreed to this kind of affiliation). The amount of alcoholic beverage is calculated in both mass and volume to allow the participants to use a measuring device that is available to them. The amount of time to drink the beverage was reduced to 10 minutes and the pause for the alcohol to take effect to 20 minutes because losing the participants because of high demands is a high risk since there is no financial or material motivation.

3.4 Cocaine administration

The dosage of cocaine was set to 1.4 milligrams per body weight kilogram. This is a bit more than a usual dose in recreational settings, but it's only used once while in real life cocaine is often redosed since the euphoric effects wear off quickly. This dose is still lower than an average dose in similar research studies. The cocaine is used intranasally via insufflation (i.e. by snorting) in 60 seconds or less. 15 minutes break is then given to allow the effects of cocaine to take place.

In the online version the dosage remains unchanged. The amount is calculated along with the alcohol amount using the same calculator as in subsection 3.3 Alcohol administration. The participants are instructed to use a precise scale to weigh the cocaine. If it's not available to them, they're instructed to do a line a bit bigger than their usual one. Otherwise the conditions are the same.

3.5 Motor task performance measures

There are generally two options for the measurement. Either the task is to transcribe a real text or to transcribe a set of random words. The real text simulates the real-world scenario better but in case of repeated measurements it allows for training-based improvements or if the text changes each time it's hard to balance the difficulty. Therefore, we have chosen to use the random set of simple words approach since it's more suitable for measuring change in performance and precise real-world performance isn't of interest for us. The test starts with the first keypress and runs for 60 seconds. Incorrectly spelled words don't count and are skipped. Backspace isn't enabled. This yields these metrics

- characters per minute (cpm),
- words per minute (wpm),
- count of incorrectly spelled words,
- typing patterns based on key press and release events.

A standard full-size computer keyboard with keyboard layout of participant's choice will be used in the ideal experiment.

Since tool exactly as described above isn't available it would have to be custom made. There wasn't time for that so an existing standardized tool similar to the ideal one will be used in the online version instead. The tool uses random set of words as described. It allows corrections but the participants are instructed not to do them. The tool is available on the following URL https://typing-speed-test.aoeu.eu/ and yields these metrics

- characters per minute (cpm),
- words per minute (wpm),
- count of incorrectly spelled words.

Since results cannot be exported only cpm is mandatory to report. We ask the participants to fill out the rest of the metrics as well, but it's possible to skip it. The participants can use any device (e.g. smartphone, laptop, PC,...) to do the measurements and the device used is reported.

4 References

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