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Cognitive enhancement drug use among university students

How do different groups of cognitive enhancement drug users and non-users differ in lifestyle characteristics?

Bachelor Thesis

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Abstract

Since the pressure to perform well or even better than others in the university increases, the usage of drugs for cognitive enhancement seems to increase as well. Not only illegal drugs but also substances that normally are prescribed for the treatment of diseases seem to get used to strengthen the cognitive performance. The goal of this study was to examine how different groups of cognitive enhancement drug users and non-users differ in their lifestyle characteristics. Therefore 175 participants completed an online survey questionnaire. Based on the group of drugs, which was chosen to enhance the cognitive performance, the participants were split into the groups of illicit and prescription drug users, prescription drug users only and non-users. The mean age of the participants was 20.8 years and the majority of them were females. The participants were asked self-developed questions about their cognitive enhancement drug use and about their lifestyle characteristics. The results showed significantly differences between the three groups in their consumption behavior, but in their health behavior no significant differences were found. As expected, illicit drug users showed a higher consumption behavior than non-users. Prescription drug users did not differ in their consumption behavior from non-users but did also not differ from the illicit drug user, which indicates a lack of clarity relating to the prescription drug users. It could be important to have a more careful look at the illicit drug users as well as the prescription drug users, because they already indicate a risk to their health in relation to their cognitive enhancement drug use.

Keywords: Cognitive enhancement drugs; Illicit drug users; Prescription drug users; Consumption behavior; Health behavior

How do different groups of cognitive enhancement drug users and non-users differ in lifestyle characteristics?

In our modern and digitalized world, life is getting more complex. The pressure to perform well or better than others in school, the university or in the job accumulates and leads to a lot of stress (Coughlan, 2011). Because of that, people try to find ways to deal with those demands. For example, in the university many students drink coffee or caffeine drinks to stay awake when they have to work for an assignment. But for some people caffeine seems to be not enough (Do cognitive-enhancing drugs work?, 2011). To strengthen their performance some individuals try to enhance their efficiency by taking cognitive enhancement drugs.

Cognitive enhancement can be defined as "the amplification or extension of core capacities of the mind through improvement or augmentation of internal or external information processing systems" (Bostrom & Sandberg, 2009). Cognition is a process an individual uses to organize information. This process consists of "acquiring information, selecting, representing, and retaining information, and using it to guide behavior" (Bostrom & Sandberg, 2009). So, cognitive enhancement drugs are taken to improve the individual's cognitive capacities to achieve a greater efficiency, for example to improve memory, increase mental alertness and concentration as well as to rise energy levels and wakefulness. Based on their legal status those drugs can be subdivided into three categories: over-the-counter drugs, prescription drugs and illicit drugs, which will be explained in more detail in the following (Franke, Bagusat, Rust, Engel & Lieb, 2014).

Over-the-counter drugs

Probably the most known and used cognitive enhancement drugs are over-the-counter drugs. Those drugs are legal and often widely accepted as a medium to enhance the cognitive efficiency, such as caffeinated drinks, like coffee or energy drinks, or caffeine tablets, but also other natural herbs or plants, like ginkgo (Franke, Bagusat, Rust, Engel & Lieb, 2014). Even nicotine can be used to relieve stress and strengthen cognitive abilities (Mehlman, 2004).

'Caffeine has been used as a stimulant for at least a thousand years' (Mehlman, 2004). Together with other over-the-counter drugs, it is widely accepted and used within the population. Therefore, in a field which regards high cognitive efficiency, such as the university, the prevalence rates can reach up to nearly 100%, as a study among Egyptian university students has shown (Al Safadi & Sunna, 2011).

Prescription drugs

The category of the prescription drugs describes substances that are normally and legally used for the treatment of physical illnesses or psychological disorders, especially drugs that are used to treat attention-deficits or hyperactivity disorders, sleep disorders or Alzheimer's disease. Often those are methylphenidates like Ritalin, amphetamines like Attentin or Adderall or narcoleptics like Modafinil (Franke, Bagusat, Rust, Engel & Lieb, 2014). However, those substances can also be used to enhance the cognitive efficiency in ways which are not regarding medical treatments, for example to enhance performance in the university. Because of that reason, those drugs are often being misused by people to which they were not prescribed (Franke, Bagusat, Rust, Engel & Lieb, 2014). The main goals of that are 'to help with concentration, increase alertness and provide a high' for the users (Teter, McCabe, Cranford, Boyd & Guthrie, 2005).

Research for the prevalence rates of prescription drug use is still limited and the data varies widely. The prevalence numbers of prescription drugs range from 3-16%, depending on whether the studies include all nonmedical drugs or only nonmedical drugs which are used with the intention to enhance one's cognitive performance. Both studies show that the prevalence of prescription drugs increases (Teter, McCabe, Cranford, Boyd & Guthrie, 2005; Schelle, Olthof, Reintjes, Bundt, Gusman-Vermeer & Van Mil, 2015).

Illicit drugs

The category of the illicit drugs sums up all substances that are illegal in a country such as amphetamines like speed, ecstasy, methamphetamines like crystal meth, opiates like heroin or psychedelics like LSD (European Monitoring Centre for Drugs and Drug Addiction, 2017). The main reasons for taking illicit drugs are at first, to reach a sense of physical and mental well-being, like getting euphoric or having a better mood, but also increasing alertness and energy or relaxing (U.S. United Nations Office on Drugs and Crime, 2016). Other possible reasons are to become intoxicated, keep awake at night while socializing, to decrease depressed moods and to enhance activity (Boys, Marsden & Strang, 2001). Because of that especially amphetamines and methamphetamines are often used for cognitive enhancement (Franke, Bagusat, Rust, Engel & Lieb, 2014).

The illicit drug use in the United States still increases. In a representative sample of the general U.S population the lifetime prevalence of illicit drug use disorders is 2-3%. From 2012 to 2013 the number of illicit drug users rose up to 8.3% (U.S. United Nations Office on Drugs and Crime, 2016). The most common used illicit drug in America is marijuana

(National Trends, 2015). In the Netherlands among the adult general population Cannabis is the most common illicit substance used, followed by MDMA and cocaine. The key period of a development of a substance use disorder is between adolescence and early adulthood (Merikangas & McClair, 2012).

Lifestyle characteristics and their relation to cognitive enhancement drug use

The term 'lifestyle' was defined by the Austrian psychologist Alfred Adler in the 1920s and was used to describe how people live their life and how they handle problems and interpersonal relations (Boeree, 2006). Therefore the willingness to use drugs to handle problems – especially with cognitive enhancement drugs – could be part of a certain lifestyle, which is related to specific lifestyle characteristics. In fact, studies indicate that people who use drugs for that purpose differ from people who do not take drugs in terms of some lifestyle characteristics. Those differences were mostly found for two specific groups of drug users: people who use illicit drugs and people who use prescription drugs. Less specific lifestyle characteristics could be found for people who use over-the-counter drugs. The reason for that is that nearly everybody uses some kind of over-the-counter drugs, which leads to very high prevalence rates, sometimes even reaching up to nearly 100% (Al Safadi & Sunna, 2011). Because of that reason lifestyle characteristics can mostly be found for the illicit and prescription drug users:

In general, illicit drug users often drink more alcohol and smoke more cigarettes than people who do not take illicit drugs and also have a younger age when they start consuming them (Kandel, Simcha-Fagan & Davies, 1986). It is also notable that people who take illicit drugs also tend to take prescription drugs very often (Teter, McCabe, Cranford, Boyd & Guthrie, 2005). Additionally, illicit drug users are more often in a depressive mood and are more physically inactive in adolescence than people who do not take illicit drugs (Paton, Kessler & Kandel, 1977; Korhonen, Kujala, Rose & Kaprio, 2009). Also, they often have an unhealthy sleep behavior, like waking up multiple times during the night or not falling asleep easily (McKnight-Eily, Eaton, Lowry, Croft, Presley-Cantrell & Perry, 2011). Furthermore, illicit drug users often show an unhealthy eating behavior, which leads to a worse nutrition (Forrester, 2006). Also, an important demographic information might be that men more often use illicit drugs than women (Barnes, Welte & Hoffman, 2002).

Users of prescription drugs also have a higher risk for drinking much alcohol and even binge-drinking or partying more in general and living in a fraternity or sorority affiliation than people who do not use prescription drugs (Teter, McCabe, Boyd & Guthrie, 2003). Less

information was found regarding the frequency of physical exercise, the amount of restful and satisfying sleep and the amount of attention that is paid to a healthy nutrition by prescription drug users. Similar to the demographics of illicit drug users, men more often use prescription drugs than women (Teter, McCabe, Cranford, Boyd & Guthrie, 2005).

Based on that information two clusters of lifestyle characteristics can be defined. Both groups of drug users seem to have similarities regarding frequent party behavior and their amount of alcohol and nicotine use. Therefore, the first cluster will contain those characteristics and will be called 'consumption behavior'. Moreover, the users of illicit drugs seem to exercise less and be more physically inactive and have an unhealthier sleep and nutrition behavior than users who do not take illicit drugs. For those characteristics no research was found in relation to prescription drug users, but because of the amount of similarities which were found before it is assumed that there might also be similarities regarding those characteristics, too. The second cluster will contain those characteristics regarding the physical health and therefore will be called 'health behavior'.

Research question and hypotheses

The previous comparisons of lifestyle characteristics between illicit drug users and people who do not take illicit drugs on the one hand and prescription drug users and people who do not take prescription drugs on the other hand, indicate that there might be similarities between people who use prescription for cognitive enhancement and people who use illicit drugs for cognitive enhancement, while there might be no similarities to non-users. Based on that assumption the central question of this research will be: How do different groups of cognitive enhancement drug users and non-users differ in lifestyle characteristics? To answer that question, the three groups (the illicit drug users, prescription drug users and non-users) will be compared to each other regarding the two clusters of lifestyle characteristics (consumption behavior and health behavior), which were defined before. The hypotheses will be the following:

1. a) Illicit drug users will have a higher consumption behavior than non-users.
   b) Prescription drug users will have a higher consumption behavior than non-users.
   c) There are no differences between illicit drug users and prescription drug users, relating to their consumption behavior.

2. a) Illicit drug users will have a lower health behavior than non-users.
   b) Prescription drug users will have a lower health behavior than non-users.
   c) There are no differences between illicit drug users and prescription drug users, relating to their health behavior.

Method

Participants

175 participants completed the study 'Cognitive enhancement drug use among university students'. All of the participants were students, approximately one-third of them were male while two-thirds were female. The mean age was 20.8 (SD= 2.28), the majority were psychology students and the nationality was predominantly German.

The participants were subdivided in three different groups. Since most users of illicit drugs also tend to use prescription drugs, the first group contained of people who used illicit drugs only (3 participants) as well as people who used illicit drugs and also used prescription drugs (16 participants) and was referred to as 'illicit drug users' (Teter, McCabe, Cranford, Boyd & Guthrie, 2005). The second group consists of people who only used prescription drugs, but did not use illicit drugs (38 participants) and was referred to as 'prescription drug users'. The third group consisted of people who neither used illicit nor prescription drugs for cognitive enhancement and was referred to as 'non-users'. This last group was used as a control group in comparison to the prescription drug users and the illicit drug users so that conclusions about distinctive characteristics of cognitive enhancement drug users in general could be made even when the results of the two groups of cognitive enhancement drug users do not differ from each other. Further information about the participants can be found in Table 1.

Table 1. Demographics subdivided for non-users, prescription drug users and illicit drug users

		Non-users (n=115)	Prescription drug users (n=38)	Illicit drug users (n=19)	Chi^2	p-value
Nationality	Dutch	17(14,8%)	4(10.5%)	1(5.3%)		
	German	88(76.5%)	26(68.4%)	15(78.9%)	5.44	0.25
	Other	10(8.7%)	8(21.1%)	3(15.8%)		
Gender	Men	26(22.6%)	13(34.2%)	9(47.4%)		
	Female	89(77.4%)	24(65.8%)	10(52,6%)	9.68	0.05

Design and Procedure

A Cross-sectional online survey design was employed. The study was approved by the ethics' commission from the faculty of BMS and was part of a larger study. It examined the cognitive enhancement drug use, lifestyle characteristics and other topics like personality traits. In April and May 2018, the participants were invited through the online website SONA, where the students could get study points for an anonymous participation in this study. The questionnaire began with an introduction. Therein it was stated which variables were measured, the estimated duration of the survey (between 30 and 40 minutes) was predicted and it was noted that all answers were given anonymously and that the participants always had the possibility to stop the study without a reason. After this, the questionnaire was conducted. At the end of the survey the participants were asked if they wanted to receive information about the results of the study and were thanked for participating in the survey.

Materials

Demographics

Participants answered different questions regarding demographics about gender, age, nationality and about their studies. For example, 'Please indicate your gender' and 'How many years are you already studying at an university?'. Through these questions, it was possible to get general information about the participants. Additional information about the demographic questions can be found in the Appendix A.

Cognitive enhancement drug use

After a definition of cognitive enhancement drugs and the three categories of them, which are based on their legal status (over the counter drugs, prescription drugs, illicit drugs), a total of nine questions followed.

Participants were at first asked if they ever made use of a substance to increase their cognitive performance which could be answered with yes or no. The participants who answered with 'no' skipped the following questions about cognitive enhancement drug use which only the students were asked who answered with 'yes'. The participants were first asked whether they used these substances. Possible answers were 'caffeine pills', 'caffeinated drinks (e.g. coffee, energy drinks), 'cigarettes/nicotine', 'alcohol' and 'cannabis/marijuana (legally bought)'. Then the participants were asked how often they used the drugs that they named. The possible answers for that were '0', '1-3' '4-10' or 'more than 10' times. Normally, the period of time regarding the amount of the usage of the drugs was set to 12 months. Because of the high prevalence and frequent usage rates, an exception was made for the answers 'caffeinated drinks' and 'cigarettes', which were reduced to weekly usage and for 'alcohol' and 'cannabis' which were reduced to monthly usage.

At second, participants were asked the same questions for the category of the prescription drugs. The possible answers were 'Methylphenidate (e.g. Ritalin, Concerta)', 'Modafinil (e.g. Provigil)', 'β-Blocker (e.g. Beloc)', 'Amphetamine (e.g. Adderal, Desoxyn, Dexedrine)', 'Fluoxetine (e.g. Prozac)', 'Piracetam (e.g. Nootropil, Dinagen, Synaptine, Qropi, Myocalm)' and 'Cannabis/Marijuana (medical, prescribed by a doctor)'. After that they were asked again about the amount of usage of the separate drugs in the last 12 months. The possible answers for this were the same as above.

At third, participants were asked the same questions for the category of the illicit drugs. The possible answers were 'Amphetamine (e.g. Speed/Pep)', 'Cocaine', 'Methylenedioxymetamphetamine/MDMA (e.g. Ecstasy)', 'Cannabis/Marijuana (illicit bought)' or 'Heroine'. Then the procedure regarding the amount of use in the last 12 months and the possible answers were repeated.

It should also be noted that for each category of cognitive enhancement drugs the participants had the option to add substances which were in accordance with the category, but not listed in the possible answers, under the point 'Others'. These substances were also examined for the amount of use in the last 12 months with the same procedure. Additional information about the cognitive enhancement drugs questions can be found in the Appendix B.

The results of the reliability tests for the drug scale for the 17 items of the over-the-counter drug scale were Cronbach's α=0.54. For the 16 items of the prescription drug scale they were Cronbach's α=0.46 and for the 13 items of the scale of the illicit drugs they were a Cronbach's α=0.68.

Lifestyle characteristics

To measure lifestyle characteristics, participants were asked 8 questions about their lifestyle characteristics trough a self-developed questionnaire.

The first four questions were asked concerning the consumption behavior. First, for 'How would you describe your weekly party behavior (going in a bar, in a club or to a house party) in hours?' the answers ranged from '1-4 hours', '5-9 hours', up to '>10 hours'. Second, for 'How would you describe your smoking behavior?' the possible answers ranged from 'I don't smoke', 'Seldom (occasion smoker)', 'Less than a half packet of cigarettes per day', 'A half packet of cigarettes per day', 'One packet of cigarettes per day', 'Two packets of cigarettes per day', 'Three packets of cigarettes per day' up to 'more than three packets of cigarettes a day'. Third, for 'How would you describe your weekly drinking behavior?' the they ranged from 'I drink no alcohol', 'Once a week', 'Twice a week', '3 days a week', up to 'more than 3 days a week' and, forth, for 'How many standard drinks containing alcohol do you have on a typical day when drinking?' they ranged from '1 or 2', '3 or 4', '5 or 6', '7 to 9', up to '10 or more'. The last question was skipped, when the participants stated that they do not drink alcohol at all.

The other four questions were asked concerning the health behavior. First, for 'How much attention do you pay for a healthy nutrition?' the answers ranged from 'None at all', 'A little', 'A moderate amount', 'A lot', to 'A great deal'. Second, for 'How often are you physically active (sports etc.)' they ranged from 'Never', 'Once a week', 'Several times a week', up to 'Everyday'. Third, for 'Are you satisfied with your sleep?' they ranged from 'not at all', 'little', 'Moderate', 'Very', up to 'very much', and fourth, for 'Do you feel restful after awaking?' they ranged from 'Never', 'Sometimes', 'Often', up to 'Always'. Additional information about the lifestyle characteristic questions can be found in the Appendix C.

The results from the reliability analysis of the 4 items of the consumption behavior scale were Cronbach's α= 0.58. The 4 items of the health behavior scale were Cronbach's α=0.59.

Data analysis

The analysis of the data is made through the program 'SPSS'. Descriptive analyzes were made to compare the demographic characteristics of the three groups. Differences between prescription drug users, illicit drug users and non-users relating to their consumption behavior and their health behavior were examined with two one-way Anova tests. Post hoc comparisons using the Bonferroni test were made to determine which means differ.

Results

Descriptive analysis

First, a descriptive analysis is made to see how often the different drugs are used. In Table 2 the drug means per substance are presented. The over-the-counter drugs like caffeinated drinks are the most used drugs. The prescription drugs like Ritalin and the illicit drugs like Cocaine are less used by the participants in this study. The most used drugs in this study were the caffeinated drinks. The less used drugs are Modafinil and Fluoxetine.

Hypothesis testing

A one-way between subjects ANOVA was conducted to compare the consumption behavior of prescription drugs users, illicit drug users and non-users of cognitive enhancement drugs. The three groups differed significantly in their consumption behavior, $F(2, 133)= 4.77$, $p=0.01$. Post hoc comparisons using the Bonferroni test indicated that the mean score for the illicit drug users ($M= 2.63$, $SD= 0.76$) was significantly different than the group of the non-users ($M=2.13$, $SD=0.53$). However, the prescription drug users ($M=2.23$, $SD=0.52$) did not significantly differ from the non-users. The illicit drug users did not significantly differ from prescription drug users.

Another one-way between subjects ANOVA was conducted to compare the health behavior of prescription drug users, illicit drug users and non-users of cognitive enhancement drugs. The three groups differ not significantly in their health behavior, $F(2, 171)=1.11$, $p=0.33$. Post hoc comparisons using the Bonferroni test indicated that the mean score for the illicit drug users ($M=2.72$, $SD=0.81$) did not significantly differ from non-users ($M=2.89$, $SD=0.53$). The mean scores for the prescription drug users ($M= 2.76$, $SD=0.69$) did also not

significantly differ from non-users. The mean scores for the illicit drug users did not significantly differ from prescription drug users. This means that the groups of illicit drug users and prescription drug users do not score significantly lower on health behavior than non-users.

Table 2. Drug means per substance

Drugs	Means (SD)
Over-the-counter-drugs	
Caffeine pills [b]	0.35 (0.90)
Caffeinated drinks [a]	1.79 (1.38)
Cigarettes/nicotine [a]	0.70 (1.39)
Alcohol [a]	0.57 (0.99)
Cannabis/Marijuana [b]	0.07 (0.42)
Prescription drugs	
Methylphenidate [c]	0.10 (0.48)
Modafinil [c]	0.01 (0.15)
Beta-Blocker [c]	0 (0)
Fluoxetine [c]	0.01 (0.15)
Piracetam [c]	0.03 (0.27)
Amphetamine [c]	0.05 (0.34)
Cannabis/Marijuana [c]	0.06 (0.43)
Illicit drugs	
Amphetamine (Speed, Pep) [c]	0.10 (0.46)
Cocaine [c]	0.06 (0.37)
Methylenedioxymetamphetamine [c]	0.10 (0.49)
Heroin [c]	0 (0)
Cannabis/Marijuana [c]	0.29 (0.94)

Note. [a] = intake frequency in last week, [b] = intake frequency in last month, [c] = intake frequency in last 12 months

Discussion

The goal of this study was to examine differences in lifestyle characteristics between people who take illicit and prescription drugs for cognitive enhancement ('illicit drug users'), people who only use prescription drugs for cognitive enhancement ('prescription drug users') and people who do not use illicit or prescription drugs for cognitive enhancement ('non-users'). The study examined whether there are differences in these three groups relating to their consumption behavior and health behavior.

Consumption behavior

The study was interested in the comparison between different groups of cognitive enhancement drug users and non-users in relation to their consumption behavior.

The results illustrate that illicit drug users indeed show a significantly higher consumption behavior in relation to non-users. This is in line with previous research which concluded that illicit drug users drink more alcohol, smoke more cigarettes and go to parties more often than non-users (Kandel, Simcha-Fagan & Davies, 1986). In opposition to that, prescription drug users do not have a significantly higher consumption behavior than non-users. This was not in line with previous research which concluded that prescription drug users drink more alcohol or smoke more cigarettes than non-users (Teter, McCabe, Boyd & Guthrie, 2003). As expected, the results showed that illicit drug users and prescription drug users do not differ significantly in their consumption behavior. This was in line with previous studies (Teter, McCabe, Boyd & Guthrie, 2003).

In practice this could mean that one should be more concerned about the group of the illicit drug users, because they already risk their health by taking illicit drugs, but additionally show a high consumption behavior regarding their use of cigarettes and alcohol. Less concern is needed for the group of the non-users, because they take no cognitive enhancement drugs and also show a lower consumption behavior. On the one hand, one could argue that in comparison to the illicit drug users less concern is needed regarding the group of the prescription drug users, because they show a similar consumption behavior than the non-users even if they use prescription drugs. On the other hand, it is necessary to look more carefully at this group, because the prescription drug users did also not differ from the illicit drug users in terms of their consumption behavior. These results indicate that there is a lack of clarity concerning the group of the prescription drug users, because they do not seem to differ from

both other groups while those two differ from each other, which is a paradox. To clarify these results further research is needed.

An alternative explanation for these results could be the unequal gender distribution of the study, since 77.4% of the non-users and 65.8% of the prescription drug users were female. Previous research has shown that the group prescription drug users was predominantly male and that prescription drug users show a higher consumption behavior than non-users (Teter, McCabe, Cranford, Boyd & Guthrie, 2005). In opposition to that, the participants of this study were predominantly female. Consequently, this could be a possible reason for the lack of clarity regarding the results.

Health behavior

The study was also interested in the differences between cognitive enhancement drug users and non-users in relation to their health behavior.

The results showed that in health behavior there are no significant differences between the three groups, neither between the illicit drug users and the non-users nor between the prescription drug users and the non-users. Illicit drug users do not show lower health behavior than non-users and prescription drug users also do not show lower health behavior than non-users. Therefore, as assumed, illicit drug users do not differ from prescription drug users in their health behavior. These results are not in line with previous research where it was stated that illicit drug users for example are more physically inactive or pay less attention to a healthy nutrition (Paton, Kessler & Kandel, 1977; Korhonen, Kujala, Rose & Kaprio, 2009).

In practice this could mean that it is not necessary to look more carefully at one of the three groups regarding their health behavior, because none of them scored significantly higher or lower than one of the other groups. Participants who take cognitive enhancement drugs do not live unhealthier than non-users.

Similar to the results regarding the consumption behavior, the unequal gender distribution of the participants could give an alternative explanation for the results regarding the health behavior. Because earlier research suggested that cognitive enhancement drug users are predominantly male and that cognitive enhancement drug users who use illicit drugs have an unhealthier way of living, it could be possible that this research found no differences in the health behavior of these three groups since the majority of the participants were female (Teter, McCabe, Cranford, Boyd & Guthrie, 2005; Barnes, Welte & Hoffman, 2002; Paton, Kessler & Kandel, 1977; Korhonen, Kujala, Rose & Kaprio, 2009).

Strengths, limitations and recommendations for future research

A strength of this research is that it adds knowledge about the characteristics of cognitive enhancement drug users, especially for the distinct groups of illicit and prescription drug users in comparison with non-users. A lot of research is made over people who use illicit drugs in general, about their characteristics and their reasons for taking those drugs (U.S. United Nations Office on Drugs and Crime, 2016). Less is known about the lifestyle characteristics of people who take illicit or prescribed drugs to enhance their cognitive performance. With the results of the study a few first impressions regarding that topic can be given.

A limitation of this study concerns the generalizability of the participating groups. The study is only generalizable for groups of mostly female psychology students from Germany. Therefore, it is not representative for other courses, nationalities or groups with different gender compositions, since there are significantly more female participants in this study than male participants. For a more representative study a more generalizable group is needed which is made up out of participants of more different nationalities, different courses and with an equal distribution of males and females.

Another limitation of this study is that the results showed a lack of clarity for the prescription drug users. Because of that reason more research about the prescription drug users is necessary. In further research more participants who take prescription drugs would be needed. This could be accomplished by not only asking students in the university, but also looking for participants in cooperation with pharmacies or hospitals.

Conclusion

In conclusion, it can be said that illicit drug users show a higher consumption behavior than non-users while they do not differ from prescription drug users. Therefore, it will be important to look more carefully at the two groups of cognitive enhancement drug users, because both of them not only use cognitive enhancement drugs but also show a similar high consumption behavior. For the non-users less concern is needed, because they neither use cognitive enhancement drugs nor show a high consumption behavior. Regarding the group of prescription drug users a lack of clarity was found, since they did not differ from the illicit drug users, nor the non-users. For clarification further research is needed.

In their health behavior, the three groups did not differ. Regarding the characteristics, which were subsumed as ‘health behavior‘, such as the quality of sleep or the awareness for a healthy nutrition, illicit drug users live as healthy as prescription drug users and non-users. Therefore, illicit drug users live as healthy as prescription drug users and as non-users.

The field of cognitive enhancement drug use and the people who take those drugs are still not examined much. Especially the group of prescription drug users is not well explored. Further research in universities or in cooperation with hospitals or pharmacies is needed for a better understanding of cognitive enhancement drug users. With this research, a first impression about some characteristics of different groups of users could be given.

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Appendix A

Demographic questionnaire

1. Are you studying at an university?
    - Yes
    - No
2. Please indicate you gender.
    - Male
    - Female
    - Other
3. Please indicate your age.
4. What is your field of study?
5. What is your nationality?
    - Dutch
    - German
    - Other
6. How many years are you already studying at university?
    - 1
    - 2
    - 3
    - 4
    - 5
    - 6
    - 7
    - >7
7. In which phase of your study are you right now?
    - B1
    - B2
    - B3
    - M1
    - M2
    - Pre-Master

Appendix B

Drug questionnaire

1. Have you ever made use of a substance (one mentioned above or another) to increase your cognitive performance?
    - Yes
    - No
2. What over-the-counter-drugs (like coffee or energy drinks, these substances can be bought at the supermarket without much effort and are therefore very easy to obtain) did you make use for cognitive enhancement?
    - Caffeine pills
    - Caffeinated drinks
    - Cigarettes/ nicotine
    - Alcohol
    - Cannabis/Marijuana
    - Other:
    - Non
3. How often did you make use of caffeine pills to enhance your cognitive performance in the past 12 month?
    - 0
    - 1-3
    - 4-10
    - more than 10
4. How often did you make use of caffeinated drinks (e.g. coffee, energy drinks) to enhance your cognitive performance in the last week?
    - 0
    - 1-3
    - 4-10
    - more than 10
5. How often did you make use of cigarettes/nicotine to enhance your cognitive performance in the last week?

- 0
- 1-3
- 4-10
- more than 10

6. How often did you make use of alcohol to enhance your cognitive performance in the last month?
    - 0
    - 1-3
    - 4-10
    - more than 10
7. How often did you make use of Cannabis/Marijuana (legally bought) to enhance your cognitive performance in the last month?
    - 0
    - 1-3
    - 4-10
    - more than 10
8. How often did you make use of the substance you referred to in the ‘others’ category in order to enhance your cognitive performance in the past 12 months?
    - 0
    - 1-3
    - 4-10
    - more than 10
9. What prescription drugs (initially designed for the treatment of disorders like ADHD or sleep disorders that are being misused for cognitive enhancement) did you make use for cognitive enhancement?
    - Methylphenidate (e.g. Ritalin, Concerta)
    - Modafinil (e.g. Provigil)
    - Beta-Blocker (e.g. Beloc)
    - Amphetamine (e.g. Adderal, Desoxyn, Dexedrine)
    - Fluoxetine (e.g. Prozac)
    - Piracetam (e.g. Nootropil, Qropi, Myocalm, Dinagen, Synaptine)
    - Cannabis/Marijuana (medical prescribed by a doctor)
    - Other:

- None

10. How often did you make use of Methylphenidate (e.g. Ritalin, Concerta) to enhance your cognitive performance in the past 12 month?
    - 0
    - 1-3
    - 4-10
    - more than 10
11. How often did you make use of Modafinil (e.g. Provigil) to enhance your cognitive performance in the past 12 months?
    - 0
    - 1-3
    - 4-10
    - more than 10
12. How often did you make use of Beta-blockers (e.g. Beloc) to enhance your cognitive performance in the past 12 months?
    - 0
    - 1-3
    - 4-10
    - more than 10
13. How often did you make use of Amphetamine (e.g. Adderal, Desoxyn, Dexedrine) to enhance your cognitive performance in the past 12 months?
    - 0
    - 1-3
    - 4-10
    - more than 10
14. How often did you make use of Fluoxetine (e.g. Prozac) to enhance your cognitive performance in the past 12 months?
    - 0
    - 1-3
    - 4-10
    - more than 10
15. How often did you make use of Piracetam (e.g. Nootropil, Qropi, Myocalm, Dinagen, Synaptine) to enhance your cognitive performance in the past 12 months?

- 0
- 1-3
- 4-10
- more than 10

16. How often did you make use of medical Cannabis/Marijuana to enhance your cognitive performance in the past 12 months?
    - 0
    - 1-3
    - 4-10
    - more than 10
17. How often did you make use of the substance you referred to in the ‘others’ category in order to enhance your cognitive performance in the past 12 months?
    - 0
    - 1-3
    - 4-10
    - more than 10
18. What illicit drugs (like ectasy or methamphetamine that are mainly used for recreational purposes but also to enhance cognition did you make use of?
    - Amphetamine (e.g. Speed/Pep)
    - Cocaine
    - Methylenedioxymetahmphetamine/MDMA (e.g. Ectasy)
    - Cannabis/Marijuana (illicit bought)
    - Heroine
    - Other:
    - None
19. How often did you make use of Amphetamine (e.g. Speed/Pep) in the past 12 months?
    - 0
    - 1-3
    - 4-10
    - more than 10
20. How often did you make use of Cocaine in the past 12 months?
    - 0
    - 1-3

- 4-10
- more than 10

21. How often did you make use of Methylenedioxymethamphetamine/MDMA (Ecstasy) in the past 12 months?
    - 0
    - 1-3
    - 4-10
    - more than 10
22. How often did you make use of illicit Cannabis/Marijuana in the past 12 months?
    - 0
    - 1-3
    - 4-10
    - more than 10
23. How often did you make use of Heroine in the past 12 months?
    - 0
    - 1-3
    - 4-10
    - more than 10
24. How often did you make use of the substance you refered to in the ‘others’ category in the past 12 months?
    - 0
    - 1-3
    - 4-10
    - more than 10

Appendix C

Lifestyle characteristics questionnaire

1. How satisfied are you with your study performance in general?
    - Extremely satisfied
    - Somewhat satisfied
    - Neither satisfied nor dissatisfied
    - Somewhat dissatisfied
    - Extremely dissatisfied
2. How many hours are you investing in your study per week (including lectures and tutorials?
    - Less than 10 hours
    - 10-19 hours
    - 20-29 hours
    - 30-39 hours
    - 40-49 hours
    - 50-59 hours
    - 60 hours or more
3. Do you have a job next to your study?
    - Yes
    - No
4. If so, how many hours do you work per week?
    - I do not work
    - 1-5 hours
    - 6-10 hours
    - 11-15 hours

- 16-20 hours
- >20 hours

5. Please indicate your living situation
    - Living with parents/family
    - Rent with roommate(s)
    - On my own place
    - Dorm or on-campus housing
    - other
6. How would you describe your weekly party behavior (going in a bar, in a club, or to a house party) in hours?
    - 1-4 hours
    - 5-9 hours
    - >10 hours
7. How would you describe your smoking behavior?
    - I don't smoke
    - Seldom (occasion smoker)
    - Less than a half packet of cigarettes per day
    - A half packet of cigarettes per day
    - One packet of cigarettes per day
    - Two packets of cigarettes per day
    - Three packets of cigarettes per day
    - More than three packets of cigarettes per day
8. How would you describe your weekly drinking behavior?
    - I drink no alcohol
    - Once a week
    - Twice a week
    - 3 days a week
    - more than 3 days a week
9. How many standard drinks containing alcohol do you have on a typical day when drinking?
    - 1 or 2
    - 3 or 4
    - 5 or 6

- 7 to 9
- 10 or more

10. How would you describe your daily caffeine use?
    - I drink no coffee
    - Seldom
    - 1-2 cups of coffee per day
    - 3-4 cups of coffee per day
    - 5-6 cups of coffee per day
    - more than 6 cups of coffee per day
11. How much attention do you pay for a healthy nutrition
    - A great deal
    - A lot
    - A moderate amount
    - A little
    - None at all
12. How often are you physically active (sport etc.)?
    - Never
    - Once a week
    - Several times a week
    - Every day
13. Are you satisfied with your sleep?
    - Not at all
    - Little
    - Moderate
    - Very
    - Very much
14. Do you feel restful after awaking?
    - Never
    - Sometimes
    - Often
    - always
15. Do you know if your friends take cognitive enhancement drugs?
    - Yes

- Maybe
- No

16. Would you take cognitive enhancement drugs because your friends do either?
    - Definitely yes
    - Probably yes
    - Might or might not
    - Probably no
    - Definitely not