About the Risks of 'Handling it Later': The Mediating Effect of Stress on the Relationship between Procrastination and CE-Drug Use among University Students

Bachelor Thesis

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Abstract

Background: With increasing pressure, expectations and competition, the use of cognitive enhancement drugs (CE-drugs) among University students has become more frequent during the last years. CE-drugs include substances such as illicit drugs, prescription medication or over-the-counter drugs, taken with the intention to enhance cognitive capacities such as attention, memory or alertness. Risks such as side-effects and addiction underline the need to examine factors involving CE-drug use to create targeted interventions. The present study investigates the hypothesized mediating effect of perceived stress on the positive relationship between academic procrastination and CE-drug use.

Method: A quantitative cross-sectional online survey design was employed, recruiting a sample of University students (*n = 252)* through convenience sampling. The survey included the Perceived Stress Scale (PSS), Questionnaire for Academic Procrastination and self-constructed items on CE-drug use. Mediation analyses were conducted with the PROCESS macro in SPSS.

Results: Results indicated significant positive relationships between academic procrastination and perceived stress, as well as between academic procrastination and CE-drug use. There was no significant positive relationship between stress and CE-drug use found, thus stress is not a mediator. 74.2% of the participants reported that they had used at least one type of CE-drug before. The most commonly used type was over-the-counter-drugs (73.41%), followed by illicit drugs (24.6%) and prescription drugs (13.1%).

Conclusion: While stress did not explain CE-drug use, procrastination has a positive relationship with both stress and CE-drug use. Procrastinators use CE-drugs as a means of coping with delayed task completion and might aim at combating negative consequences such as lower grades. In the present study, higher CE-drug use prevalence rates were found than in previous studies with similar samples, emphasizing the need to monitor CE-drug use trends in Europe. The results further point out the necessity for theory-grounded interventions against CE-drug use with a focus on procrastination.

Introduction

Cognitive Enhancement Drug Use

With rising competition, societal expectations and pressure to succeed academically, students' use of cognitive enhancement drugs (CE-drugs) has strongly increased during the last years (Varga, 2012). CE-drug use is defined by the use of substances by healthy individuals with the aim to improve emotional and motivational functions, as well as cognitive capacities such as attention, concentration, learning and memory (Bostrom & Sandberg, 2009; Repantis, Schlattmann, Laisney, & Heuser, 2010; Sattler, Sauer, Mehlkop, & Graeff, 2014). Commonly used CE-drugs can be categorized in three groups: over-the-counter drugs (OTC-drugs), prescription drugs for the treatment of certain disorders, and illicit drugs (Busardò, Kyriakou, Cipolloni, Zaami, & Frati, 2016).

The first group of cognitive enhancers constitutes OTC-drugs, including caffeine, nicotine, energy drinks or herbal extracts such as Ginkgo Biloba (Bostrom & Sandberg, 2009). Caffeine is a widely used stimulant consumed in the form of food, medication, caffeine pills, or drinks such as coffee, tea, soft drinks and energy drinks (Nehlig, 2010). Dependent on the dose, caffeine has been shown to reduce fatigue, diminish reaction time, positively impact mood and increase diligence and attention (Giles et al., 2012; Nehlig, 2010). However, side effects from large doses can include gastrointestinal problems, headaches, anxiety, nervousness, tachycardia and insomnia or sleep disturbances (Pallarés et al., 2013). Another common stimulant is nicotine, which interacts with attention and memory and can improve working memory and the engagement of cognitive processes (Bostrom & Sandberg, 2009; Rusted, Trawley, Heath, Kettle, & Walker, 2005). The most common form of nicotine ingestion is tobacco smoking, which is one of the leading causes of premature death and preventable diseases such as cardiovascular disease, cancer and pulmonary disease (Benowitz, 2010). Lastly, over-the-counter CE-drugs include herbal extracts such as Ginkgo Biloba, which has cognition enhancing and neuroprotective properties (Das et al., 2002).

The next group of CE-drugs encompasses prescription drugs aimed at treating disorders such as attention deficit hyperactivity disorder (ADHD), postural orthostatic tachycardia syndrome, Alzheimer's disease or dementia, narcolepsy, and shift work sleep disorder (Sattler, Sauer, Mehlkop, & Graeff, 2013). Medications for these disorders encompass methylphenidate, (dextro-) amphetamine, donepezil, and modafinil, all of which can potentially enhance cognitive functions in healthy individuals (Sattler et al., 2013). The most common prescription drugs used for cognitive enhancement are the stimulants methylphenidate (Ritalin) and (dextro-) amphetamines (Adderall), the use of which is

primarily for the treatment of ADHD (Outram, 2010). Apart from enhancing their cognitive capacities, individuals use Adderall and Ritalin to increase drive, energy, and mood, i.e. motivational factors (Ilieva & Farah, 2013). The risks of misusing ADHD medication include addiction and side effects such as decreased appetite, insomnia, headache, irritability, weight loss and depression (Busardò et al., 2016). Further prescription substances used as CE-drugs include dementia medications such as donepezil, galantamine, or rivastigmine, which improve episodic memory and attention but can induce side effects such as nausea or gastrointestinal upset (Husain & Mehta, 2011). Lastly, modafinil (e.g. Provigil) belongs to the group of prescription CE-drugs. Originally developed as a medication for narcolepsy, it can be applied to reduce decreases in performance due to sleep loss, reduce stress and improve attention and working memory, with small side effects and risks of dependency (Béracochéa et al., 2008; Bostrom & Sandberg, 2009).

The last category of CE-substances includes illicit drugs such as cocaine, ecstasy, amphetamines or marijuana (Busardò et al., 2016). Illicit substances are usually taken for enjoyment; however, they are categorized as CE-drugs when exclusively used for the purpose of improving cognitive functions (Franke et al., 2011). The use of illicit drugs for cognitive enhancement brings a wide array of risks, ranging from addiction to drug-dependent side-effects (Franke et al., 2011).

To date, studies on CE-drug use have not yielded consistent results on prevalence rates, which might be due to different sampling procedures, methods of calculating prevalence rate and types of CE-drugs included (e.g. Dietz et al., 2013; Herman-Stahl, Krebs, Kroutil, & Heller, 2007; McCabe, Knight, Teter, & Wechsler, 2004). In the United States, the estimated lifetime prevalence of nonmedical use of prescription stimulants among college students ranges from 6.9% to 18.6% (Arria et al., 2011). However, differences in drug prescription and administration between the United States and European countries might limit the comparability of the populations (Eickenhorst, Vitzthum, Klapp, Groneberg, & Mache, 2012). Specifically, structural factors of access control in North America make prescription drugs such as opioids more easily and/or widely available in the population (Fischer, Keates, Bühringer, Reimer, & Rehm, 2014). This results in higher prescription drug volume, the opportunity for consecutive distribution and adverse consequences such as drug abuse (Fischer et al., 2014). A survey of a German sample showed a period prevalence rate of 7% for illicit drug use and nonmedical use of prescription drugs during the studies (Eickenhorst et al., 2012), while a survey of a Dutch sample reported a prevalence rate of 1.3% for illicit CE-drug use and 1.7% for nonmedical prescription drug use with the intention of cognitive

enhancement (Schelle et al., 2015). A survey in Germany found a 12-month prevalence of 20 % for illicit and prescription stimulant drugs and caffeine tablets (Dietz et al., 2013). Thus, it can be seen that the prevalence rates are not consistent. This lack of consistency further relates to studies on factors driving students' willingness to use CE-drugs (Sattler et al., 2014; Schelle et. al, 2015). One factor that has been identified in research is the attempt to use CE-drugs as a coping strategy for high study demands, performance pressure and stress (Liakoni et al., 2015; Wolff & Brand, 2013). Thus, it might be that with rising pressure, study demands and expectations for high achievement, students resort to the use of CE-drugs to deal with stress and improve their performance.

Stress in University Students

In today's society, stress is a common occurrence in people's everyday lives. First described in 1936 by Selye, it constitutes the organism's attempt to adjust to novel circumstances (Selye, 1936). Thus, stress itself is non-specific and merely describes the organism's reaction to an external or internal stressor. Stressors are acute or chronic incidents or situations that individuals can perceive as dangerous to their physical, social or psychological health (Jensen, Forlini, Partridge, & Hall, 2016). Individuals confronted with demands or circumstances that are exceedingly high or low can experience distress, defined by feelings of restlessness, anxiety or nervousness (Selye, 2013). When a situation is appraised as overwhelming and exceeding the individual's coping resources, it can result not only in distress but also maladaptive coping strategies (Wolff & Brand, 2013).

For University students, stress can stem from different sources such as academic and financial issues, challenges with interpersonal relationships, high workloads, difficulties with time management or fear of academic failure (Pierceall & Keim, 2007). Particularly undergraduate students significantly experience stress, and first-year University students are especially susceptible to stress due to transitioning from school life to University life and entering a new education system, lifestyle and social environment (Elias, Ping, & Abdullah, 2011). High levels of academic stress have been shown to decrease academic performance, overall adjustment and self-confidence (Elias et al., 2011). Further, high perceived levels of stress can lead to lower self-esteem, poor physical health, and poor health habits such as smoking, drinking, not exercising or not having breakfast (Hudd et al., 2000). To manage academic stress and its negative effects, many students employ coping strategies such as social support, leisure activities and exercise. However, common attempts at reducing stress further include drinking, smoking, and the use of illicit drugs and CE-drugs (Middendorff,

Poskowsy, & Isserstedt, 2012; Pierceall & Keim, 2007). These maladaptive coping strategies have further been linked to the habit of delaying the completion of academic tasks until the last moments before the deadline (Sirois & Kitner, 2015).

Academic Procrastination

Academic procrastination is defined as the inclination to postpone intended academic responsibilities, disregarding potential negative consequences (Patrzek, Sattler, van Veen, Grunschel, & Fries, 2014; Simpson & Pychyl, 2009). This voluntary delay of an intended activity represents a disruption of self-regulation and arises mostly when the task at hand is seen as aversive (Sirois & Pychyl, 2013). Students with a high tendency to procrastinate appear to benefit from the short-term effects of delaying their tasks, as they experience less stress and health problems in the early project phase (Tice & Baumeister, 1997). However, with a decreasing timeframe for completing their tasks, procrastinating students might experience a deadline effect, i.e. suffer from higher pressure and stress as they reach the time limit (Patrzek et al., 2014).

Delaying the completion of academic responsibilities can lead to a range of negative consequences for students' success in University, including long-term effects such as decreased performance and lower grades (Patrzek et al., 2014; Tice & Baumeister, 1997). In addition, academic procrastination can cause a wide range of health-related problems. The constant postponement of tasks has been associated with an accumulation of stress, which in turn can repress immune functions and lead to poor mental and physical health (Sirois & Pychyl, 2013; Stead, Shanahan, & Neufeld, 2010). Health-related consequences include exhaustion, illness, sleep disorders, depression and anxiety (Sirois & Pychyl, 2013; Steel & Klingsieck, 2016). Apart from that, procrastination can lead to affective consequences such as anger, shame, dissatisfaction, sadness, guilt and negative self-evaluations, leading to emotional and psychological fatigue (Sirois & Pychyl, 2015).

To deal with the stress arising from delayed tasks, procrastinators often use maladaptive coping strategies such as drug use, alcohol use or avoidant coping (Sirois & Kitner, 2015). Avoidant strategies include selecting other activities than the task at hand, providing short-term relief by eliminating unpleasant feelings associated with the academic responsibility (Jensen et al., 2016). Procrastinators use drugs as an avoidant coping strategy to distract themselves from the task and avoid feelings of stress, however, when the deadline is approaching, they might use CE-drugs to increase their cognitive functions in an attempt to apply a problem-focused coping strategy (Jensen et al., 2016). Thus, academic procrastination

seems to constitute a risk factor for drug use both with and without the intention of enhancing cognition.

Academic Procrastination, Stress and CE-Drug Use

To create successful interventions targeting CE-drug use, it is crucial to identify the underlying determinants and their relationships. Academic procrastination and perceived levels of stress are two variables that have been linked to CE-drug use. The relationship between them will be investigated further.

First of all, students using CE-drugs commonly report higher levels of stress compared to students who do not use CE-drugs (Schelle et al., 2015; Wolff & Brand, 2013). Both perceived stress levels and the effort to cope with it have been associated with the intention to use CE-drugs (Middendorff et al., 2012; Ponnet et al., 2014; Wolff & Brand, 2013). In particular, students utilizing CE-drugs aim at decreasing feelings of anxiety and stress, for instance during exams (Deline et al., 2014). Thus, students intend to regulate their stress levels and their ability to cope with study-related stressors by using CE-drugs, i.e. there might be a positive relationship between stress and CE-drug use.

Academic procrastination can be a reason for high stress levels (Stead et al., 2010). In addition, current research shows that procrastinators display a higher willingness to use CE-drugs than students who do not habitually delay assignments (Sattler et al., 2014). The underlying presumption is that students with high levels of academic procrastination use CE-drugs as means of coping with the negative effects of postponing tasks, such as stress, dissatisfaction, negative self-evaluations and lower performance (Sattler et al., 2015). A recent study on University students' coping strategies and use of CE-drugs has found that procrastinators employed avoidant strategies until their stress levels were intolerable (Jensen et al., 2016). After that, they exchanged their avoidant strategies for the 'problem-focused' approach of using CE-drugs to accomplish their University requirements. Thus, procrastinators might use CE-drugs to improve their efficacy and counteract consequences such as decreased performance, lower grades and stress.

Despite growing interest in determinants leading to CE-drug use, research exploring academic procrastination, academic stress and CE-drug use is limited. Previous research indicates correlations between procrastination and stress, procrastination and CE-drug use and stress and CE-drug use (e.g. Sattler et al., 2014; Schelle et al., 2015; Wolff & Brand, 2013). However, the mediating role of stress has not been examined to date. The present study targets this gap by investigating the relationship between procrastination and CE-drug use

with stress as a mediator. The goal is to create an increased understanding of reasons for CE-drug use to enable the development of carefully targeted interventions counteracting the rising prevalence of CE-drug use. The current study aims at answering the following research question:

"Is there a relationship between procrastination tendencies of University students and their frequency of cognitive enhancement drug use, which is mediated by their perceived levels of stress?"

The research question encompasses the following hypotheses:

H1: There is a significant positive relationship between students' tendency for academic procrastination and their use of CE-drugs.
H2: There is a significant positive relationship between students' perceived levels of stress and their use of CE-drugs.
H3: There is a significant positive relationship between students' tendency for procrastination and their perceived levels of stress.
H4: The significant positive relationship between academic procrastination and CE-drug use is mediated by students' perceived levels of stress.

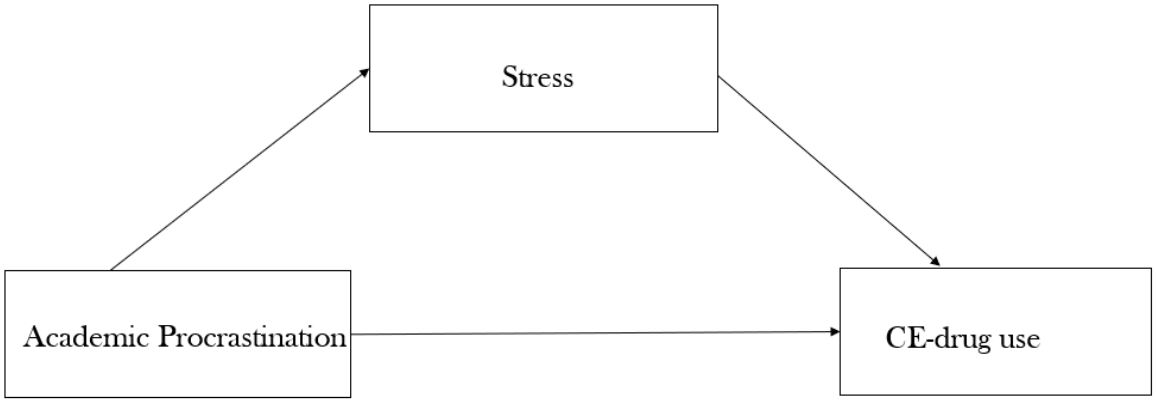

Figure 1. The hypothesized model of the relation between academic procrastination, perceived levels of stress and CE-drug use.

Methods

Design

The current study employed a quantitative cross-sectional online survey design. This design was chosen as it is especially suitable for investigating the prevalence of a behavior in a population at a given time (Sedgwick, 2014). Apart from that, cross-sectional studies are relatively quick, easy and cheap to conduct (Sedgwick, 2014). The study used academic procrastination as the independent variable and CE-drug use as dependent variable. The self-reported level of perceived stress was adopted as a mediator.

Participants

Participants were University students (n = 263), recruited through convenience sampling. Participants included 194 women and 58 men between the ages of 18 and 32 (M = 20.74, SD = 1.96). Recruitment was done through social networks of the researchers, social media channels such as Facebook and SONA, which is an online environment used by Universities to gather participants for research. Subjects recruited via SONA received half a SONA credit as an exchange for their participation. Inclusion criteria for participants were that they studied at a University or University of Applied Science, had a proficient understanding of the English language, and were at least 18 years old by the time of the data collection. After the data collection, 11 participants had to be excluded due to not completing all items of the questionnaire, resulting in a final sample of 252 participants. Table 1 includes additional socio-demographic characteristics of participants.

Table 1

Socio-demographic Characteristics of Participants (n = 252).

Item	*M (SD)*	Category	Frequency	Percentage
Age (years)	20.74 (1.96)			
Gender		Female	194	77.0
		Male	58	23.0
Nationality		German	203	80.6
		Dutch	28	11.1
		Other	21	8.3
Phase of study		First Year Bachelor	177	70.2
		Second Year Bachelor	35	13.9
		Third Year Bachelor	29	11.5
		First Year Master	2	.8
		Second Year Master	5	2.0
		PhD	1	.4
		Other	3	1.2

Measuring Instruments

The data were collected through an online questionnaire constructed and administered through the platform Qualtrics. Qualtrics is a software for collecting and analyzing data, including different tools to create online surveys. The questionnaire included a self-constructed questionnaire on demographics, a self-constructed questionnaire on CE-drug use, the Perceived Stress Scale (PSS) and the Questionnaire for Academic Procrastination (QAP).

Demographics. To collect general information on the participants, questions regarding demographics were constructed, including items on age, gender, nationality and phase of studies by the time of the data collection.

CE-Drug Use. To measure participants' frequency of CE-drug use, up to 36 self-constructed items about their CE-drug use behavior were asked (see Appendix A). The items were self-constructed due to the lack of an existing, validated questionnaire on CE-drug use. The questionnaire on CE-drug use was divided into three categories: illicit drugs, OTC-drugs and

prescription drugs. First of all, participants were explained the different categories of CE-drugs and given examples for every category or drug (see Appendix A). Further, they were asked if and which category of CE-drug they had used before with the intention of enhancing cognitive functions. If the answer was 'No', the survey automatically skipped the questions about the frequency of CE-drug use. Depending on their answers, participants were asked which drugs of the respective categories they had used before, with examples of the drugs as answer options, and the space to add another drug they used in case it was not listed. The questionnaire included items such as '*Which of the following over-the-counter substances have you used before with the intention to enhance your cognitive functions?*' and *'Which of the following prescription drugs have you used before with the intention to enhance your cognitive functions?'*. For every drug they indicated to have used, participants were asked how often they had used the drug in the past 12 months and in the past 4 weeks. Follow-up questions on the frequency of use included items such as *'In the past 12 months, how often did you use Methylphenidate (e.g. Ritalin, Concerta) to enhance your cognitive functions?'* and *'In the past 4 weeks, how often did you use caffeinated drinks (e.g. coffee, tea, energy drinks) to enhance your cognitive functions?'.* The answers ranged from 0 *(0 times)*, 1 *(1-3 times)*, 2 *(4-10 times)* to 3 *(more than 10 times).* The questionnaire was scored by summing up the scores on the items, with a higher score indicating a higher frequency of CE-drug use. The questionnaire was scored in the subscales 12-months CE-drug use frequency and 4-weeks CE-drug use frequency.

Stress. To measure participants' levels of perceived stress, the 10-item version of the Perceived Stress Scale (PSS) by Cohen was used (Cohen, Kamarck, & Mermelstein, 1983). The PSS is a widely used quantitative self-report measure assessing the extent to which an individual evaluates situations in their life as stressful (Cohen et al., 1983). The questionnaire includes 10 items rated on a 5-point Likert-scale, with possible answers ranging from 0 *(Never)* to 4 *(Very Often).* The items are formulated in an easy language and in a general way, asking about participants' thoughts and feelings during the last month (e.g. *'In the last month, how often have you felt that things were going your way?', 'In the last month, how often have you found that you could not cope with all the things you had to do?'*). To score the PSS, the positively formulated items 4, 5, 7 and 8 were reverse coded in SPSS (e.g. 0=4, 1=3). All item scores were accumulated, resulting in a high score indicating a high level of perceived stress. Scores on the PSS range from 0 to 40. A review of psychometric evidence of the PSS including various student samples showed adequate reliability, with high hypothesis validity

and factorial validity (Lee, 2012). In a sample of undergraduate students, the PSS had a Cronbach's alpha of α = .89 (Roberti, Harrington, & Storch, 2006). In the present sample, good internal consistency reliability was found, with a Cronbach's alpha of α = .77.

Academic Procrastination. To measure students' tendency to procrastinate, the Questionnaire for Academic Procrastination (QAP) was administered. The QAP is a quantitative self-report measure, consisting of eight items referring to the intention-action gap and different stages of task-processing (Patrzek et al., 2014). The questionnaire includes items such as *'I don't continue working on a university assignment, although I intended to.'*, *'Although I plan to work on a University assignment, I don't do it.' or 'When I plan to start working on a university assignment, I stick to this plan.'.* The responses were measured on a six-point Likert-scale ranging from 1 *(Never)* to 6 *(Always).* To score the QAP, the scores were accumulated, with a range of 8 to 48. A higher score on the QAP indicates a higher tendency for academic procrastination. Items 2, 4, 6 and 8 were reverse coded for analysis due to positive phrasing, e.g. *'If I intend to finish a University assignment, I do it.'* The QAP has shown substantial internal consistency, with a Cronbach's alpha value of α > .93 and high correlations with the Tuckman Procrastination scale in a student sample (r = .77) (Patrzek et al., 2014). In the present sample, a Cronbach's alpha of α = .82 was found, indicating high internal consistency reliability.

Procedure. Prior to data collection, ethical approval was obtained through the Ethics Committee of the University of Twente. The data were collected from the 26.03.2019 until the 22.04.2019. After signing up for the study via SONA, students were redirected to the questionnaire on Qualtrics. Participants recruited through the researchers' personal networks received recruiting messages including information on the topic and duration of the study. Further, participants were informed about requirements for completing the study, i.e. a functioning laptop or mobile device and working internet connection, followed by an expression of gratitude and the direct link to the questionnaire on Qualtrics.

The first page of the questionnaire included information on the study including background, aim and informed consent form (see Appendix B). Participants were informed about the nature and duration of the study (estimated duration of the study was between 10 and 30 minutes), the anonymous processing of their data, their right to withdraw from the study at any time and contact details of the researchers for possible questions or concerns. This was followed by two answer choices: *'Yes, I agree to participate'* to start the

questionnaire or *'No, I want to quit'* to skip to the end of the survey. Following, the study displayed the questionnaires that had to be filled in. At the end of the questionnaire, a message expressing gratitude followed and the researchers' contact information in case of questions, comments or doubts was provided again. Apart from that, the last page of the survey included a field for the participants to fill in their email address in case they were interested in the outcome of the study, again emphasizing the anonymity of their data.

Statistical Analysis. The collected data were processed and analyzed with SPSS v25 (IBM, 2017). Firstly, the data were checked to exclude subjects who did not complete the whole questionnaire or did not meet one or more of the inclusion criteria. The descriptive statistics including means, standard deviations, Kurtosis and Skewness of all variables were determined. Cut-off scores of -1 and +1 were set for Kurtosis and Skewness to check the normality of the data. To determine internal consistency reliability, Cronbach's alpha was determined for the QAP and PSS. Acceptable values of Cronbach's alpha range from .70 to .95 (Tavakol & Dennick, 2011).

To test the hypotheses H1-H4, a mediation analysis was conducted using the PROCESS macro (Hayes, 2017). The analysis was conducted with procrastination as independent variable, perceived stress as mediator and CE-drug use as dependent variable. The analyses were executed twice, testing both 12-months frequency and 4-weeks frequency CE-drug use as a dependent variable. In the first step of the mediation model, a regression of procrastination on CE-drug use was conducted, testing *H1: There is a significant positive relationship between students' tendency for academic procrastination and their use of CE-drugs.* In the second step, perceived stress was predicted using procrastination, testing *H3: There is a significant positive relationship between students' tendency for procrastination and their perceived levels of stress.* Lastly, CE drug-use was predicted using both procrastination and perceived stress, testing *H2: There is a significant positive relationship between students' perceived levels of stress and their use of CE-drugs* and *H4: The significant positive relationship of academic procrastination and CE-drug use is mediated by students' perceived level of stress.* A significance level of $\propto < .05$ was employed. The mediation model was tested using 5,000 bootstrap samples. The macro defines a statistically significant mediation if the confidence interval does not contain zero.

Results

Descriptive Statistics and Content Analysis

Descriptive statistics of the key study variables can be found in Table 2. The Kurtosis and Skewness values of academic procrastination and perceived stress were between -1 and +1, meaning that the data were distributed normally (see Table 2). The Skewness values of 12 months and 4 weeks CE-drug use frequency were higher than 1, indicating that the values were right-skewed. The Kurtosis values of 12-months and 4-weeks CE-drug use were higher than 3, indicating a leptokurtic distribution of the data.

Table 2

Descriptive Statistics of Key Study Variables

Variable	*M*	*SD*	Skewness	Kurtosis
4-weeks CE-drug use frequency (range: 0-64)	1.36	4.73	1.68	4.47
12-months CE-drug use frequency (range: 0-64)	1.97	2.89	2.58	8.14
Perceived Level of Stress (range: 0-40)	20.57	7.50	.04	-.36
Academic Procrastination (range: 8-48)	22.35	6.97	.28	-.09

Note. n = 252.

Concerning CE-drug use in general, 74.2% of the participants reported that they had used at least one substance with the intention of enhancing their cognitive functions before. The most frequently used category was OTC-drugs (73.41%), followed by illicit drugs (24.6%) and prescription drugs (13.1%). Table 3 shows the rate of use for the specific CE-drugs, while Figures 1-3 illustrate the mean frequencies for 12-months CE-drug use and 4-weeks CE-drug use.

Table 3

Rate of Overall CE-Drug Use

Category	Drug	Lifetime prevalence (in %)	*n*
OTC-drugs	Caffeinated drinks	71.8	182
	Caffeine tablets	14.3	37
	Nicotine/cigarettes	27.0	69
	Herbal extracts	10.3	26
	Other OTC-drugs	7.9	18
Prescription drugs	Methylphenidate	9.5	24
	Amphetamines	5.2	13
	Modafinil	1.6	4
	Antidementia drugs	0.0	0
	Other prescription drugs	2.4	5
Illicit drugs	Amphetamines	6.7	17
	Methamphetamines	0.4	1
	Ecstasy	5.6	14
	Cocaine	3.97	10
	Marijuana	20.2	52
	Other illicit drugs	2.0	4

Notes. OTC-drugs = over-the-counter drugs. *n = 252.*

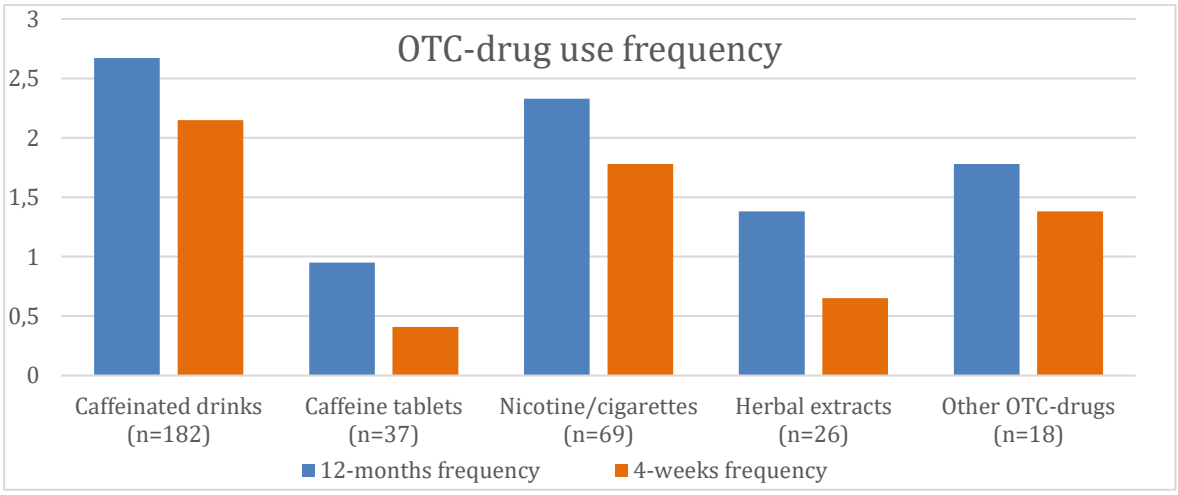

Figure 1. OTC-drug use frequency, ranging from 0 *(0 times)* to 3 *(4-10 times).*

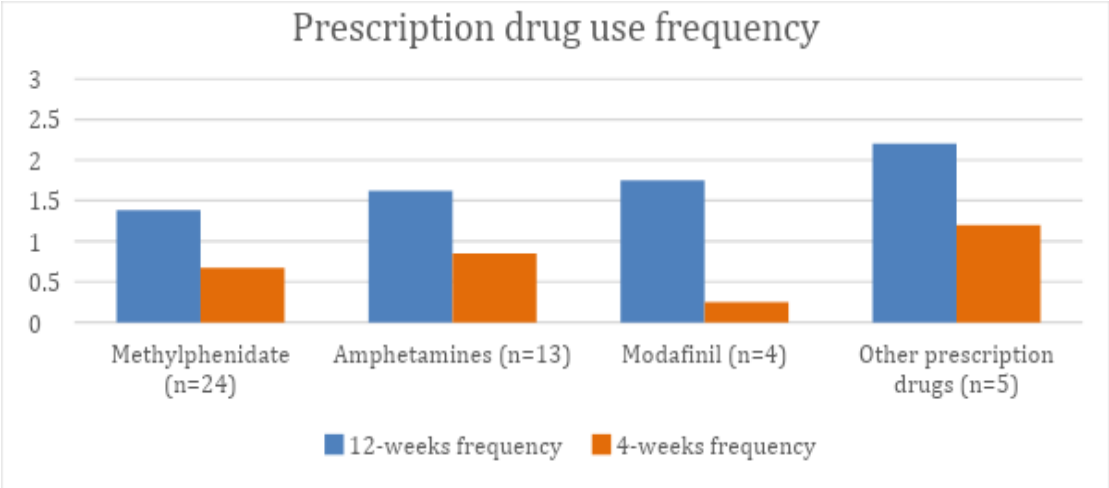

Figure 2. Prescription drug use frequency, ranging from 0 *(0 times)* to 3 *(4-10 times).*

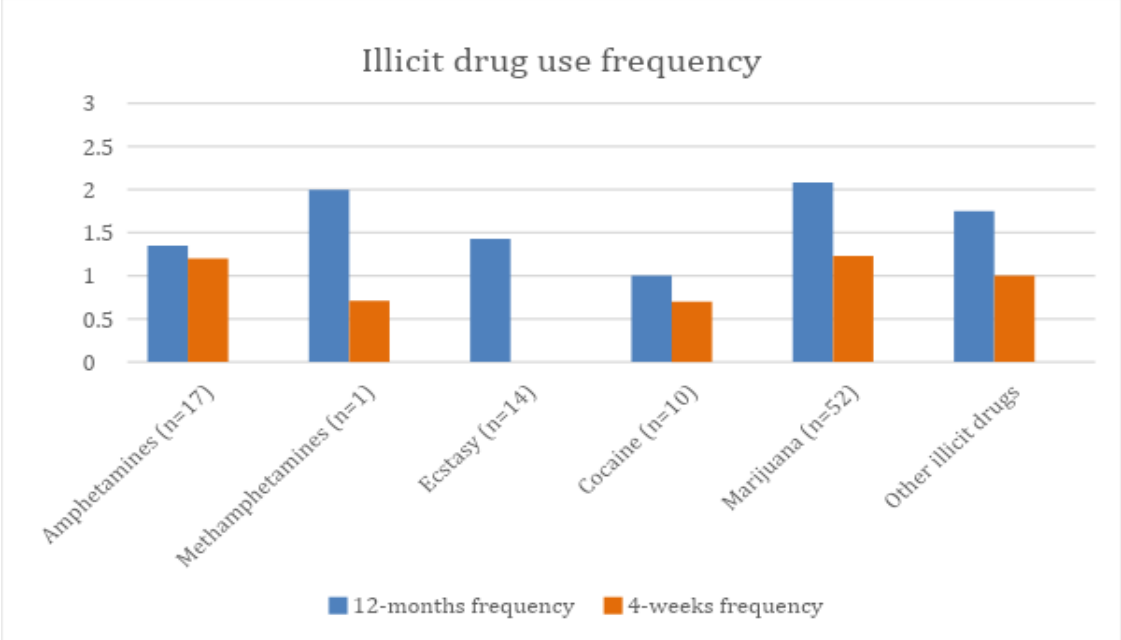

Figure 3. Illicit drug use frequency, ranging from 0 *(0 times)* to 3 *(4-10 times).*

Mediation Analysis

Table 4 shows the results of the mediation analysis for both 4-weeks frequency and 12-months frequency of CE-drug use. The second step of the mediation model indicated a significant effect of academic procrastination on perceived stress, $b = .36$, $t(250) = 5.5$, $p < .001$.

12-months CE-drug use frequency. In the first step of the mediation model, the regression of procrastination on 12-months CE-drug use frequency without the mediator was significant

b = .07, *t*(250) = 2.60, *p* = .01. Controlling for procrastination, regression of perceived stress on 12-months CE-drug use frequency was not significant, *b* = .03, *t*(249) = 1.34, *p* = .18. The last step of the analyses showed that controlling for perceived stress, procrastination still had a significant effect on 12-months CE-drug use frequency, *b* = .05, *t*(249) = 2.01, *p* = .04. Testing the effect of academic procrastination on 12-months CE-drug use frequency with perceived stress as a mediator, no significant indirect effect was found, *b* = 0.01, SE = .01, *CI* [-.01, .03]. Thus, the results do not indicate a mediating effect of perceived stress on the positive relationship between academic procrastination and 12-months CE-drug use frequency.

4-weeks CE-drug use frequency. In the first step of the mediation model, a significant effect of procrastination on 4-weeks CE-drug use frequency was found *b* = .03, *t*(250) = 2.23, *p* = .03. Regression of perceived stress on 4-weeks CE-drug use frequency was not significant when controlling for procrastination, *b* = .03, *t*(249) = 1.78, *p* = .08. In the last step of the model, controlling for perceived stress, there was no significant effect of procrastination on 4-weeks CE-drug use frequency, *b* = .02, *t*(249) = 1.53, *p* = .13. There was no significant indirect of perceived stress on 4-weeks CE-drug use frequency found, *b* = 0.01, SE = .01, *CI* [0, .02]. Accordingly, there is no mediation of perceived stress on the relationship between academic procrastination and 4-weeks CE-drug use.

Conclusion. The results of the analyses indicate a significant direct effect of procrastination on CE-drug use, leading to the acceptance of H1. There was no significant positive relationship of perceived stress and CE-drug use found, thus H2 is rejected. The analyses further indicated a significant positive relationship between procrastination and perceived stress, leading to the acceptance of H3. Lastly, the results indicate that perceived stress does not mediate the positive relationship between academic procrastination and CE-drug use, leading to the rejection of H4.

Table 4

The Indirect Effect of Perceived Stress on the Relationship between Academic Procrastination and 12-months/4-weeks CE-Drug Use Frequency

	Outcome: Perceived Stress					Model		
	b	*SE*	*t*	*p*	*R*	R^2	*F*	*p*
Procrastination	*.36*	.06	*5.53*	*.00***	*.33*	.11	30.64	.00
	Outcome: 12-months CE-drug use frequency					Model		
	b	*SE*	*t*	*p*	*R*	R^2	*F*	*p*
Perceived Stress	.03	.03	1.34	.18	.18	.03	4.28	.01
Procrastination	.06	.03	2.01	.04*				
	Outcome: 4-weeks CE-drug use frequency					Model		
	b	*SE*	*t*	*p*	*R*	R^2	*F*	*p*
Perceived Stress	.02	.01	1.78	.08	.18	.03	4.08	.01
Procrastination	.02	.02	1.53	.13				
	Indirect Effect 12-months CE-drug use frequency							
	b		*BootSE*	*BootLLCI*		*BootULCI*		
Perceived Stress	.01		.01	-.01		.03		
	Indirect Effect 4-weeks CE-drug use frequency							
	b		*BootSE*	*BootLLCI*		*BootULCI*		
Perceived Stress	.01		.01	0		.02		

*Notes. * $p < .05$. ** $p < .01$.*

Discussion

The purpose of the current study was to get insight into the mediating role of stress on the relationship between academic procrastination and the consumption of CE-drugs among University students to provide theoretical grounds for interventions targeting CE-drug use. The study set out to answer the research question *"Is there a relationship between procrastination tendencies of University students and their frequency of cognitive enhancement drug use, which is mediated by their perceived levels of stress?"*. The results implicate that a mediation effect is not present, however other significant relationships were found, providing insight especially into academic procrastination as a factor influencing both stress and CE-drug use.

First, the results showed a significant positive relationship between academic procrastination and CE-drug use, i.e. students with a higher tendency to procrastinate used CE-drugs more often than students who procrastinated less. This is consistent with the findings of Sattler et al. (2014), whose study firstly showed that academic procrastination positively influences students' willingness to use CE-drugs. The present study went further and showed that actual CE-drug use also increases with higher procrastination tendencies. This effect can be explained in terms of coping strategies (Jensen et al., 2016; Sirois & Kitner, 2015; Sirios & Pychyl, 2013). Specifically, procrastinators are initially more likely to use maladaptive coping strategies such as avoidant and disengagement coping. However, when their initial coping approach does not longer decrease stress, students with high procrastination tendencies reappraise their strategies and aim at adapting alternative, problem-focused methods such as the use of CE-drugs (Jensen et al., 2016). This explains the positive effect of academic procrastination on CE-drug use found in the current study: students with a higher propensity to procrastinate use CE-drugs more frequently as means of adapting a problem-focused coping strategy to deal with stressors such as assignments and approaching deadlines.

Another factor that has previously been related to CE-drug use was stress. However, the current findings did not support the hypothesized significant positive relationship between students' perceived level of stress and their frequency of CE-drug use. In line with this, the hypothesized mediating effect of perceived stress on the positive relationship between academic procrastination and CE-drug use could not be confirmed. These results are unexpected, given the positive association of stress and CE-drug use found in research (Middendorff et al., 2012; Ponnet et al., 2014; Schelle et al., 2015). The higher frequency of CE-drug use among students with higher stress levels is explained by the effort to manage stress and deal with study-related responsibilities (Wolff & Brand, 2013). This effect could not be found in the current sample, which might be clarified when considering the specific types of CE-drugs. Especially users of specific prescription drugs have been shown to report higher stress levels than their non-using counterparts (Schelle et al., 2015). A study by Deline et al. (2014) found that the use of CE-drugs is also in line with the specific drug's purpose, for instance, the use of anxiety-reducing medications such as anti-depressants or beta-blockers to relieve stress and anxiety. However, stimulating cognitive enhancers such as ADHD-medication and coffee are mainly used with the purpose of increasing wakefulness and overall cognitive functions (Deline et al., 2014). The present study mainly investigated stimulating substances, and the prevalence rate of prescription drugs and stress-reducing medication such

as modafinil or antidepressants was quite low. Thus, it is possible that there is an effect of stress on CE-drug use particularly for substances aimed at reducing stress and anxiety, but this effect might have not been detected in the current sample due to the low prevalence rate of these drugs and the focus on stimulants. Alternatively, it could simply mean that stress itself is not a predictor of CE-drug use, however, stress-related factors such as overextension and the use of maladaptive coping strategies might be involved (Selye, 2013; Wolff & Brand, 2013). This is in line with the fact that students who frequently use CE-drugs report not only feeling stressed but also overwhelmed by extensively high demands (Middendorff et al., 2012; Wolff & Brand, 2013). Moreover, while both procrastination and stress are associated with maladaptive coping strategies, it might be that procrastinators use CE-drugs merely as means of shifting to problem-focused strategies. It is possible that students consume CE-drugs, specifically stimulants, to counteract other effects of their procrastination such as decreased performance or lower grades, but not stress.

Further, the current study found a positive relationship between academic procrastination and perceived stress. This result is in agreement with other research investigating the effects of procrastination and reporting adverse consequences such as poor physical and mental health, elevated stress and anxiety levels, and decreased performance (Patrzek et al., 2014; Ponnet et al., 2000; Stead et al., 2010; Tice & Baumeister, 1997). Despite initial benefits from procrastination such as less stress and pressure during the initial project phase, procrastination has been shown to have a cumulative negative effect on stress and health. Particularly, the stress imposed by academic responsibilities does not merely move to the later project phase but rather increases when deadlines approach, along with physical and mental illness (Tice & Baumeister, 1997). This effect could be shown in the current sample, highlighting that academic procrastination is an important predictor of stress.

When interpreting the results, it is crucial to consider the validity and reliability of the study design. First of all, it can be said that the online set-up of the questionnaire and anonymity of respondents adds to the validity of the study. As a result of the anonymity, it can be excluded that participants answered inaccurately due to social desirability; thus, it can be assumed that the results constitute an accurate representation of CE-drug use in the sample. Further, the questionnaire included several explanations of CE-drug use and particularly highlighted the difference between recreational use and use with the aim of cognitive enhancement. Every item on CE-drugs asked about the frequency of use specifically with the purpose of enhancing cognitive functions, thus preventing inclusion of recreational use in the data. Therefore, it is highly probable that the results only encompass drug use with the

purpose of cognitive enhancement, which speaks for the accuracy of the results. Apart from that, the scales used in the questionnaire had good internal consistency reliability, with a Cronbach's Alpha of $\alpha = .77$ for the Perceived Stress Scale and $\alpha = .82$ for the Questionnaire for Academic Procrastination. Lastly, the results on the relationship between procrastination and stress and procrastination and CE-drug use converge with previous research, supporting the accuracy of the findings.

However, the present study also includes some limitations that should be considered when interpreting the results. First of all, the sample was quite homogenous in ethnicity and gender, encompassing a majority of German females in the first year of their Bachelor studies. The homogeneity of the sample might limit the generalizability to other populations and thus decrease external validity. This limitation can be overcome in future studies by employing a more diverse sample of University students of different ethnicities, genders and study phases. Further, the questionnaire items on CE-drug use mostly included stimulating but not stress-relieving drugs, and the use of CE-drugs was classified together without differentiating between stimulants and tranquilizers. This might have made a possible effect of stress on the use of certain CE-drugs undetectable. Separating types of CE-drugs might show whether the impact of stress depends on the type of substance and clarify whether certain drugs are used more frequently when stress levels are higher. In addition, the answer options of the questionnaire were not very broad, ranging only up to the answer '10 times or more', which might have restricted the differentiation of heavier CE-drug users. Future research might address this issue by developing a standardized questionnaire on the use of CE-drugs including a differentiation of a wide scope of types of CE-drugs and frequency of use. Moreover, qualitative research might be employed to examine factors in relation to specific types of CE-drugs and to investigate the role of stress. For instance, conducting interviews with students who habitually use certain CE-drugs might provide insight into causes and effects of cognitive enhancement, as well as differences between patterns for the three categories of CE-drugs. This might also foster understanding of the role of stress for different CE-drug types. Using an explorative approach might aid in identifying causes for CE-drug use to develop theory-grounded interventions aimed at reducing consumption and negative consequences such as abuse, addiction and health-adverse side effects.

The present study addressed CE-drug use as an increasing issue in society, especially for University students, with the aim of drawing conclusions for practice and further research. The CE-drug use prevalence rates found in the current sample were higher than in previous studies with European samples of University students, emphasizing the importance of

monitoring the development of CE-drug use. Since recent studies have indicated an increase in methylphenidate prescriptions in Europe, accessibility, distribution and prevalence rate for nonmedical use might grow (Deline et al., 2014). Due to adverse consequences for mental and physical health including side effects, addiction and illness, it is crucial to observe trends concerning the use of CE-drugs and develop targeted interventions to decrease drug consumption. By identifying academic procrastination as a driving factor in CE-drug use among University students, the current study sets theoretical grounds for creating these interventions.

To date, the study was the first one to examine a possible mediating effect of stress on the positive relationship between stress and CE-drug use, targeting a research gap concerning constructs involved in CE-drug use. Current studies have investigated procrastination (Sattler et al., 2015) and stress (e.g. Ponnet et al., 2014; Schelle et al., 2015) in relation with CE-drug use, but not their interaction. While the mediating role of stress has not been confirmed, the findings on the positive effect of procrastination on stress and CE-drug use have important practical implications. First of all, it is crucial for interventions against CE-drug use to target procrastination. By providing students with constructive, problem-focused means of dealing with their procrastination tendencies, the use of CE-drugs as a last resort to increase efficiency and manage deadlines might decrease. Apart from that, combating procrastination is an important aspect in reducing stress levels and ultimately improving mental and physical health. Possible solutions include time management strategies such as a personalized, realistic study plan outlining study times and learning goals (Ponnet et al., 2014). Interventions against procrastination and associated CE-drug use could aim at teaching self-regulated learning, goal setting and estimating typical durations for assignments (Patrzek et al., 2014). Time-management training focusing on prioritizing, strategy development, concrete goal setting, daily planning and monitoring has been shown to decrease procrastination and perceived stress (Häfner, Stock, & Oberst, 2014). Interventions imparting time-management and goal-setting plans should be communicated through different channels at University, including not only counseling services but also lectures (Patrzek et al., 2014). In particular, at the beginning of a course, teachers might share their own strategies for completing tasks and assist students in establishing awareness on suitable starting dates for assignments (Patrzek et al., 2014). Effectively targeting academic procrastination should decrease stress and CE-drug use among University students.

Conclusion

The present study investigated the mediating role of stress on the positive relationship between academic procrastination and CE-drug use. The results showed no mediating effect but a positive relationship between procrastination and stress, as well as procrastination and CE-drug use. This finding, as well as recent developments concerning CE-drug use, emphasize the importance of establishing theory-based interventions and practices against CE-drug use and procrastination. Future research should focus further on underlying constructs of delaying tasks and the development and implementation of effective interventions against procrastination. Targeting procrastination and providing students with adequate strategies against ‘handling it later’ should decrease not only stress but also CE-drug use.

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Appendix A

Questionnaire on CE-drug use

In the following, you will be asked about your use of Cognitive Enhancement (CE) drugs.

CE-drugs include any type of substance that is used by **healthy individuals** to **enhance motivation or cognitive functions** such as **alertness, attention, memory, concentration or learning**.

CE-drugs can be divided into three groups:

1) **Over-the-counter (OTC) CE-drugs** include any cognition enhancing substance that can be bought without a doctor's prescription, such as caffeine, energy drinks, nicotine, or herbal extracts.
2) **Prescription CE-drugs** include the **nonmedical** use of medicines (without a doctor's prescription) for diseases such as ADHD, dementia, narcolepsia or shift work sleep disorder.
3) **Illicit CE-drugs** include drugs such as amphetamines, ecstasy, cocaine or illicit marijuana, **used with the purpose of enhancing cognition.**

Q2 Have you ever used one of the mentioned substances to enhance motivation or cognitive functions such as alertness, attention, memory, concentration or learning?

- ○ Yes (1)
- ○ No (4)

Skip To: Q38 If Have you ever used one of the mentioned substances to enhance motivation or cognitive functions s... = No

Q3 Which of the following **over-the-counter substances** have you used before with the intention to enhance your cognitive functions?

- ☐ Caffeinated drinks (e.g. coffee, tea, energy drinks) (1)
- ☐ Caffeine tablets (3)
- ☐ Nicotine/ cigarettes (4)
- ☐ Herbal extracts (e.g. Ginkgo biloba, Ashwagandha) (5)
- ☐ Other, namely (8) _____
- ☐ ⊗None of these (9)

Display This Question:

If Which of the following over-the-counter substances have you used before with the intention to enh... = Caffeinated drinks (e.g. coffee, tea, energy drinks)

Q4 **In the past 12 months,** how often did you use **caffeinated drinks (e.g. coffee, tea, energy drinks)** to enhance your cognitive functions?

- 0 times (1)
- 1-3 times (2)
- 4-10 times (3)
- More than 10 times (4)

Display This Question:

If Which of the following over-the-counter substances have you used before with the intention to enh... = Caffeinated drinks (e.g. coffee, tea, energy drinks)

Q5 **In the past 4 weeks,** how often did you use **caffeinated drinks (e.g. coffee, tea, energy drinks)** to enhance your cognitive functions?

- 0 times (1)
- 1-3 times (2)
- 4-10 times (3)
- More than 10 times (4)

Display This Question:

If Which of the following over-the-counter substances have you used before with the intention to enh... = Caffeine tablets

Q6 **In the past 12 months,** how often did you use **caffeine tablets** to enhance your cognitive functions?

- ○ 0 times (1)
- ○ 1-3 times (2)
- ○ 4-10 times (3)
- ○ More than 10 times (4)

Display This Question:

If Which of the following over-the-counter substances have you used before with the intention to enh... = Caffeine tablets

Q7 **In the past 4 weeks,** how often did you use **caffeine tablets** to enhance your cognitive functions?

- ○ 0 times (1)
- ○ 1-3 times (2)
- ○ 4-10 times (3)
- ○ More than 10 times (4)

Display This Question:

If Which of the following over-the-counter substances have you used before with the intention to enh... = Nicotine/ cigarettes

Q8 **In the past 12 months,** how often did you use **cigarettes/nicotine** to enhance your cognitive functions?

- ○ 0 times (1)
- ○ 1-3 times (2)
- ○ 4-10 times (3)
- ○ More than 10 times (4)

Display This Question:

If Which of the following over-the-counter substances have you used before with the intention to enh... = Nicotine/ cigarettes

Q9 **In the past 4 weeks,** how often did you use **cigarettes/nicotine** to enhance your cognitive functions?

- ○ 0 times (1)
- ○ 1-3 times (2)
- ○ 4-10 times (3)
- ○ More than 10 times (4)

Display This Question:

If Which of the following over-the-counter substances have you used before with the intention to enh... = Herbal extracts (e.g. Ginkgo biloba, Ashwagandha)

Q10 **In the past 12 months,** how often did you use **herbal extracts (e.g. Ginkgo Biloba, Ashwagandha)** to enhance your cognitive functions?

- 0 times (1)
- 1-3 times (2)
- 4-10 times (3)
- More than 10 times (4)

Display This Question:

If Which of the following over-the-counter substances have you used before with the intention to enh... = Herbal extracts (e.g. Ginkgo biloba, Ashwagandha)

Q11 **In the past 4 weeks,** how often did you use **herbal extracts (e.g. Ginkgo Biloba, Ashwagandha)** to enhance your cognitive functions?

- 0 times (1)
- 1-3 times (2)
- 4-10 times (3)
- More than 10 times (4)

Display This Question:

If If Which of the following over-the-counter substances have you used before with the intention to enhance your cognitive functions? Other, namely Is Not Empty

Q12 **In the past 12 months,** how often did you use **the over-the-counter substance you referred to as other** to enhance your cognitive functions?

- 0 times (1)
- 1-3 times (2)
- 4-10 times (3)
- More than 10 times (4)

Display This Question:

If If Which of the following over-the-counter substances have you used before with the intention to enhance your cognitive functions? Other, namely Is Not Empty

Q13 **In the past 4 weeks,** how often did you use **the over-the-counter substance you referred to as other** to enhance your cognitive functions?

- 0 times (1)
- 1-3 times (2)
- 4-10 times (3)
- More than 10 times (4)

Page Break

Q14 Which of the following **prescription drugs** have you used before with the intention to enhance your cognitive functions?

- ☐ Methylphenidate (e.g. Ritalin, Concerta) (1)
- ☐ Amphetamines (e.g. Adderall) (2)
- ☐ Modafinil (e.g. Provigil) (3)
- ☐ Antidementia drugs (e.g. Piracetam, Donepezil) (4)
- ☐ Other, namely (6) _____
- ☐ ⊗None of these (7)

Display This Question:

If Which of the following prescription drugs have you used before with the intention to enhance your... = Methylphenidate (e.g. Ritalin, Concerta)

Q15 In the **past 12 months**, how often did you use **Methylphenidate (e.g. Ritalin, Concerta)** to enhance your cognitive functions?

- ○ 0 times (1)
- ○ 1-3 times (2)
- ○ 4-10 times (3)
- ○ More than 10 times (4)

Display This Question:

If Which of the following prescription drugs have you used before with the intention to enhance your... = Methylphenidate (e.g. Ritalin, Concerta)

Q16 In the **past 4 weeks**, how often did you use **Methylphenidate (e.g. Ritalin, Concerta)** to enhance your cognitive functions?

- 0 times (1)
- 1-3 times (2)
- 4-10 times (3)
- More than 10 times (4)

Display This Question:

If Which of the following prescription drugs have you used before with the intention to enhance your... = Amphetamines (e.g. Adderall)

Q17 In the **past 12 months**, how often did you use **amphetamines (e.g. Adderall)** to enhance your cognitive functions?

- 0 times (1)
- 1-3 times (2)
- 4-10 times (3)
- More than 10 times (4)

Display This Question:

If Which of the following prescription drugs have you used before with the intention to enhance your... = Amphetamines (e.g. Adderall)

Q18 In the **past 4 weeks**, how often did you use **amphetamines (e.g. Adderall)** to enhance your cognitive functions?

- ○ 0 times (1)
- ○ 1-3 times (2)
- ○ 4-10 times (3)
- ○ More than 10 times (4)

Display This Question:

If Which of the following prescription drugs have you used before with the intention to enhance your... = Modafinil (e.g. Provigil)

Q19 In the **past 12 months**, how often did you use **Modafinil (e.g. Provigil)** to enhance your cognitive functions?

- ○ 0 times (1)
- ○ 1-3 times (2)
- ○ 4-10 times (3)
- ○ More than 10 times (4)

Display This Question:

If Which of the following prescription drugs have you used before with the intention to enhance your... = Modafinil (e.g. Provigil)

Q20 In the **past 4 weeks**, how often did you use **Modafinil (e.g. Provigil)** to enhance your cognitive functions?

- ○ 0 times (1)
- ○ 1-3 times (2)
- ○ 4-10 times (3)
- ○ More than 10 times (4)

Display This Question:

If Which of the following prescription drugs have you used before with the intention to enhance your... = Antidementia drugs (e.g. Piracetam, Donepezil)

Q21 In the **past 12 months**, how often did you use **Antidementia drugs (e.g. Piracetam, Donepezil)** to enhance your cognitive functions?

- ○ 0 times (1)
- ○ 1-3 times (2)
- ○ 4-10 times (3)
- ○ More than 10 times (4)

Display This Question:

If Which of the following prescription drugs have you used before with the intention to enhance your... = Antidementia drugs (e.g. Piracetam, Donepezil)

Q22 In the **past 4 weeks**, how often did you use **Antidementia drugs (e.g. Piracetam, Donepezil)** to enhance your cognitive functions?

- 0 times (1)
- 1-3 times (2)
- 4-10 times (3)
- More than 10 times (4)

Display This Question:

If If Which of the following prescription drugs have you used before with the intention to enhance your... Other, namely Is Not Empty

Q23 In the **past 12 months**, how often did you use **the prescription drug you referred to as other** to enhance your cognitive functions?

- 0 times (1)
- 1-3 times (2)
- 4-10 times (3)
- More than 10 times (4)

Display This Question:

If If Which of the following prescription drugs have you used before with the intention to enhance your... Other, namely Is Not Empty

Q24 In the **past 4 weeks**, how often did you use **the prescription drug you referred to as other** to enhance your cognitive functions?

- 0 times (1)
- 1-3 times (2)
- 4-10 times (3)
- More than 10 times (4)

Page Break

Q25 Which of the following **illicit drugs** have you used before with the intention to enhance your cognitive functions?

- ☐ Amphetamines (1)
- ☐ Methamphetamines (2)
- ☐ Ecstasy (3)
- ☐ Cocaine (4)
- ☐ Marijuana (5)
- ☐ Other, namely (6) _____
- ☐ ⊗None of these (7)

Display This Question:

If Which of the following illicit drugs have you used before with the intention to enhance your cogn... = Amphetamines

Q26 In the past 12 months, how often did you use **amphetamines** to enhance your cognitive functions?

- 0 times (1)
- 1-3 times (2)
- 4-10 times (3)
- More than 10 times (4)

Display This Question:

If Which of the following illicit drugs have you used before with the intention to enhance your cogn... = Amphetamines

Q27 In the past 4 weeks, how often did you use **amphetamines** to enhance your cognitive functions?

- 0 times (1)
- 1-3 times (2)
- 4-10 times (3)
- More than 10 times (4)

Display This Question:

If Which of the following illicit drugs have you used before with the intention to enhance your cogn... = Methamphetamines

Q28 In the past 12 months, how often did you use **methamphetamines** to enhance your cognitive functions?

- 0 times (1)
- 1-3 times (2)
- 4-10 times (3)
- More than 10 times (4)

Display This Question:

If Which of the following illicit drugs have you used before with the intention to enhance your cogn... = Methamphetamines

Q29 In the past 4 weeks, how often did you use **methamphetamines** to enhance your cognitive functions?

- 0 times (1)
- 1-3 times (2)
- 4-10 times (3)
- More than 10 times (4)

Display This Question:

If Which of the following illicit drugs have you used before with the intention to enhance your cogn... = Ecstasy

Q30 In the past 12 months, how often did you use **ecstasy** to enhance your cognitive functions?

- 0 times (1)
- 1-3 times (2)
- 4-10 times (3)
- More than 10 times (4)

Display This Question:

If Which of the following illicit drugs have you used before with the intention to enhance your cogn... = Ecstasy

Q31 In the past 4 weeks, how often did you use **ecstasy** to enhance your cognitive functions?

- 0 times (1)
- 1-3 times (2)
- 4-10 times (3)
- More than 10 times (4)

Display This Question:

If Which of the following illicit drugs have you used before with the intention to enhance your cogn... = Cocaine

Q32 In the past 12 months, how often did you use **cocaine** to enhance your cognitive functions?

- 0 times (1)
- 1-3 times (2)
- 4-10 times (3)
- More than 10 times (4)

Display This Question:

If Which of the following illicit drugs have you used before with the intention to enhance your cogn... = Cocaine

Q33 In the past 4 weeks, how often did you use **cocaine** to enhance your cognitive functions?

- 0 times (1)
- 1-3 times (2)
- 4-10 times (3)
- More than 10 times (4)

Display This Question:

If Which of the following illicit drugs have you used before with the intention to enhance your cogn... = Marijuana

Q34 In the past 12 months, how often did you use **marijuana** to enhance your cognitive functions?

- 0 times (1)
- 1-3 times (2)
- 4-10 times (3)
- More than 10 times (4)

Display This Question:

If Which of the following illicit drugs have you used before with the intention to enhance your cogn... = Marijuana

Q35 In the past 4 weeks, how often did you use **marijuana** to enhance your cognitive functions?

- 0 times (1)
- 1-3 times (2)
- 4-10 times (3)
- More than 10 times (4)

Display This Question:

If If Which of the following illicit drugs have you used before with the intention to enhance your cogn... Other, namely Is Not Empty

Q36 In the past 12 months, how often did you use **the illicit substance you referred to as other** to enhance your cognitive functions?

- 0 times (1)
- 1-3 times (2)
- 4-10 times (3)
- More than 10 times (4)

Display This Question:

If If Which of the following illicit drugs have you used before with the intention to enhance your cogn... Other, namely Is Not Empty

Q37 In the past 4 weeks, how often did you use **the illicit substance you referred to as other** to enhance your cognitive functions?

- 0 times (1)
- 1-3 times (2)
- 4-10 times (3)
- More than 10 times (4)

Appendix B

Informed Consent Form

Researchers: Lisa-Marie Andres, Nastassja Volkov

Dear Participant,

thank you for participating in this online study about the use of cognitive enhancement drugs among university students.

With increasing competition, societal expectations and pressure, students' use of cognitive enhancement drugs (CE-drugs) has strongly increased during the last years. Cognitive enhancement is defined as the use of a substance by a healthy individual to improve motivational functions and cognitions such as memory, concentration, attention and learning. Dependent on the choice of drug, these can lead to negative consequences such as addiction and side effects. Even though insight on the motives for using CE-drugs is needed to develop targeted interventions, research on these factors is still in its infancy. The purpose of the current study is to address this gap by **investigating factors leading to CE-drug use, particularly stress, perfectionism and procrastination.**

The survey will take about 20 minutes to complete. To complete this survey, you will need a laptop/computer/mobile device and a working internet connection. The study includes multiple-choice questions about your use of CE-drugs (frequency, type of CE-drug), a questionnaire on your perfectionism level, tendency to procrastinate and lastly, some demographical questions.

We kindly ask you to **read the questions carefully** and to **answer all questions honestly**. All data is kept **anonymously,** and personal information will not be passed on to third parties under any condition. Under no circumstances will any personal data or identifying information be included in the report of this research. Nobody, except the two researchers and the two supervisors will have access to the anonymized data in its entirety. Participation in this study is entirely voluntarily and you can **withdraw at any time.**

If you have any questions about the study, please contact the researchers Lisa-Marie Andres (l.andres@student.utwente.nl) or Nastassja Volkov (n.volkov@student.utwente.nl).

By clicking on 'Yes, I agree to participate', you declare the following:

I hereby declare that I have been informed in a clear manner about the aim and method of this study. Furthermore, I participate on my own free will and I am aware that I can withdraw from this research at any time without having to mention a reason. Information about anonymity and how to get in contact with the researchers in case of questions or comments are clear to me.

Do you agree to participate in this study?

- ○ Yes, I agree to participate
- ○ No, I do not agree

Skip To: End of Survey If Dear Participant, thank you for participating in this online study about the use of cognitive enh... = No, I do not agree