



# UNIVERSITY OF TWENTE.

Faculty of Behavioural, Management  
& Social Sciences

## The relationship between coping, stress and cognitive enhancement drug use

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## RELATIONSHIP BETWEEN COPING, STRESS AND CE DRUG USE

### **Abstract**

*Background:* While there is already research done on the relationship between coping styles and cognitive enhancement (CE) drug use, there is no research done that tries to investigate possible mediating variables on that relationship. The goal of this research was to gain insights into the relationship between coping styles and CE drug use, with stress as a possible mediating variable.

*Method:* The participants ( $n = 175$ ) of this study were assigned through a university study-recruitment website and the personal network of the researchers. The participant's age ranged from 18 to 30 ( $M = 20.79$ ;  $SD = 2.42$ ), while 72% of the sample were female and 27.4% were male. The majority of participants were German (75.4%), followed by Dutch participants (12.6%). Participants filled in an online questionnaire, which measured stress, CE drug use and coping behaviours.

*Results:* The results showed that neither functional coping nor dysfunctional coping could be related to CE drug use. Accordingly, stress could not mediate the relationship between the coping styles and CE drug use.

*Conclusion:* Even though coping has proven to be predicting CE drug use in previous research on that topic, the current study could not provide proof for this relationship and accordingly also not for stress as a possible mediating variable in this relationship. Possibly, cross-cultural differences in coping behaviours could account for the non-existence of this relationship in the present study, as previous research on that relationship was conducted in Australian university samples. Also, as literature showed a low prevalence rate of German students for CE drug use, the scores on that scale in the current study might have insufficient variance in order to establish relationships with other variables. Future research is needed in order to assess possible cross-cultural differences in CE drug use and its predictors.

*Keywords:* Coping, Stress, Cognitive Enhancement, Mediation, Perceived Stress Scale, COPE Inventory, CE drug use

## Introduction

### *Cognitive Enhancement*

In the recent years, as the demand for cognitive neuroscience increased, for instance due to an increasingly aging population (Grady, 2008), so did the number of cognitive enhancement (CE) techniques in order to improve different aspects of cognition, such as the executive functioning, the working memory or the creativity (Riddell, Jensen & Carter, 2017). Cognitive enhancement can be achieved through many different disciplines or measures, which can be split up into *conventional* and *unconventional* means of enhancing cognition, according to Bostrom and Sandberg (2009). The most fundamental conventional form of cognitive enhancement is learning and training itself. Here, not only specific skills or subjects are taught, but also more general mental functions and processes are improved, such as memory, concentration and critical thinking. Other forms of mental training, such as yoga, martial arts and meditation are seen as techniques to enhance cognition.

Caffeine, which aims to improve alertness, can be seen as the most widely used conventional substance in order to enhance cognition (Bostrom & Sandberg, 2009). This substance can be seen as an *over-the-counter drug* (Lessenger & Feinberg, 2008). Over-the-counter drugs are substances that do not require a prescription and are sold in stores, markets and pharmacies (Collins & McAllister, 2006). Another over-the-counter drug that is used in order to enhance cognition is Phenylpropanolamine. Originally, this substance is a decongestant. An overdose or non-medical use creates a *physical high* and enhances cognition. As nicotine is also associated with a temporary increase in attention and memory, it can also be seen as an over-the-counter drug that can enhance cognition (Rezvani & Levin, 2001). As over-the-counter drugs can be used in order to enhance cognition, they are seen as CE drugs (Solomon, Adams, Silver, Zimmer & DeVeaux, 2002).

Unconventional means of enhancing cognition are for example gene-therapies, neuro-implants or *prescribed CE drugs*, also often referred to as *nootropics* or *neuroenhancers* (Forlini & Racine, 2009; Bostrom & Sandberg, 2009). Many different forms of CE drugs can be found in the literature (Farah et al., 2004): different stimulants (Lee & Ma, 1995; Soetens, Hueting, Casaer & D'Hooge, 1995), nutrients (Meikle, Riby & Stollery, 2005) and hormones (Gulpinar & Yegen, 2004) are associated with enhanced

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cognition. Among the stimulants are for example prescription drugs such as methylphenidate (MPH, e.g. Ritalin), originally aimed as therapy for attention deficit hyperactivity disorder (ADHD), and modafinil, which is originally used to treat narcolepsy (Wilens et al., 2008). Those stimulants are often misused by healthy individuals in order to enhance their cognitive functioning (Bright, 2008). A lifetime prevalence rate of 1.3% for prescription drug use in order to enhance cognition was found in a German sample in the study conducted by Franke et al. (2011).

Another form of unconventional CE drugs are *illicit drugs* that are being used to improve cognition. For example, amphetamines, cocaine and ecstasy (MDMA) are used with this purpose (Franke et al., 2011). The lifetime prevalence rate for illicit stimulants is at 2.6%, according to Franke et al. (2011).

The misuse of cognitive-enhancing substances is associated with a greater risk of getting addicted to those substances (Compton & Volkow, 2006) and with an increase in psychological distress and internal restlessness (Weyandt et al., 2009; Leshner, 1997). Misuse of those substances can accordingly lead to severe consequences for consuming individuals. Mental health consequences of drug use in order to enhance cognition often involve depressions and anxiety (Patton et al., 2002), while also neurotoxin containing drugs, such as methylenedioxymethamphetamine (MDMA), can impair the memory significantly in the long-term (Gowing, Henry-Edwards, Irvine & Ali, 2002). Physical health consequences of CE drug use, such as the use of cocaine, often are either myocardial infarctions (MIs) or strokes (Qureshi, Suri, Guterman & Hopkins, 2001). In the United States, strokes accounted for about one out of eighteen deaths in 2007, which would mean that more than 5 percent of the deaths in the US are results of strokes (Roger et al., 2011). Therefore, CE drug use not only impairs the psychological functioning of the user, but also puts his physical health in great danger. Possible risk factors of non-medical drug use in order to enhance cognition have to be assessed in order to create efficient interventions that try to decrease such behaviors and the accompanying mental and physical consequences.

Research on the reasons for taking cognitive-enhancing substances is mostly performed in North America (Rabiner et al., 2009; Peterkin, Crone, Sherdian & Wise, 2011). The improvement of the concentration was found to be the most popular motive for taking cognitive enhancement drugs. An

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attempted increase in memory capacity and creativity was also named as a reason to take those substances (Farah, Haimm, Sankoorikal & Chatterjee, 2009). Due to the fact that stress is associated with cognitive impairment, it might also be possible, that stress is a motive to use cognitive enhancement drugs in order to compensate the cognitive impairment (Yuen et al., 2012).

### ***Stress***

In 1984, Lazarus and Folkman described in their book "Stress, Appraisal, and Coping" the *stress and coping theory* (Lazarus & Folkman, 1984). This theory states, that the level of stress a person is experiencing is influenced by the two processes *cognitive appraisal* and *coping*. Cognitive appraisal consists of *primary* and *secondary appraisal*. In a stressful situation, a person first evaluates the importance of the outcome of this situation (primary appraisal). For example, a person evaluates whether this particular situation is beneficial or harmful to him/herself. Subsequently, the person evaluates possible actions that can be done in order to prevent harmful outcomes or to promote beneficial outcomes (secondary appraisal). This leads to the second process of the *stress and coping theory*: coping. The action that is evaluated to be the most beneficial during the *secondary appraisal* phase is adapted and performed. The chosen coping strategies have a direct influence on the level of stress a person is experiencing, as some coping strategies are more beneficial in particular situations than others. Coping was defined by Folkman and Lazarus as „the cognitive and behavioral efforts made to master, tolerate or reduce external and internal demands and conflicts among them“ (Folkman & Lazarus, 1980, p. 223).

So far, research mainly focused on the relation between stress and CE drug use in general (Franke et al., 2013; Sinha, 2001) or on the relation between study-related stress and cognitive enhancement drug use (Maier, Liechti, Herzig & Schaub, 2013). A study conducted in a Swiss university student sample by Maier et al. (2013) showed, that 28 % of the participants who rated their perceived stress in the highest category actually participated in prescription drug or drug abuse in general in order to enhance their cognition. Accordingly, stress seemed to be a predictor of CE drug use, but, so far, no effects of other variables on that relationship are examined.

As cognitive appraisal and coping are described as the main components of the concept of stress, those two components are meant to have influence on the level of stress a person is experiencing

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(Lazarus & Folkman, 1984). As cognitive appraisal leads to the evaluation and adaption of different coping styles, it is expected that coping has a direct relationship with stress, while the relationship between cognitive appraisal and stress is expected to be mediated by coping. Therefore, the focus of the present study will be on the relationship between stress, CE drug use and coping.

### ***Coping***

Coping can take different forms: *Problem-focused coping* concentrates on controlling and managing the stressful stimulus itself, whereas the *emotion-focused coping* strategy attempts to control the emotions that are related to the stressful stimulus (Folkman & Lazarus, 1980). This model was extended and modified by Carver, Scheier & Weintraub (1989). They proposed to combine the scales of emotion-focused and problem-focused coping into a *functional coping* scale and added *dysfunctional coping* to the existing model, in order to distinguish between helpful and unhelpful coping techniques. Dysfunctional coping can take different forms (Carver et al., 1989). Focussing on, and venting of emotions, denial, behavioural disengagement, mental disengagement, and alcohol and drug use are possible forms of dysfunctional coping. Riddell et al. (2017) examined the relation between different coping strategies and CE drug use, without taking into account possible underlying variables. It was observed, that dysfunctional coping strategies are associated with an increase in the likelihood of using cognitive enhancement drugs. Jensen, Forlini, Partridge and Hall (2016) found out that students with more realistic and functional coping strategies are more likely to maintain a manageable stress-level. In the same study it is assumed that this might lead to a decrease in CE behaviours.

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### *The current study*

Conclusively, as coping seems to be influencing the level of stress a person is experiencing (Lazarus & Folkman, 1984) and as stress seems to be a predictor of CE drug use (Franke et al., 2013; Sinha, 2001; Maier et al., 2013), it can be suggested that the relationship between coping and CE drug use is mediated by the level of stress. As Riddell et al. (2017) found out that dysfunctional coping strategies increase the likelihood of using CE drugs, it can be suggested that dysfunctional coping might increase the level of stress, which, in turn, might increase CE drug use. Functional coping might, in turn, decrease CE drug use, as the study by Jensen et al. (2016) assumes a negative relationship between those variables. As stress is expected to be a mediating variable between coping and CE drug use, functional coping is also expected to have a negative relationship with the level of stress. The proposed mediation models are illustrated in Figure 1 and Figure 2 below.

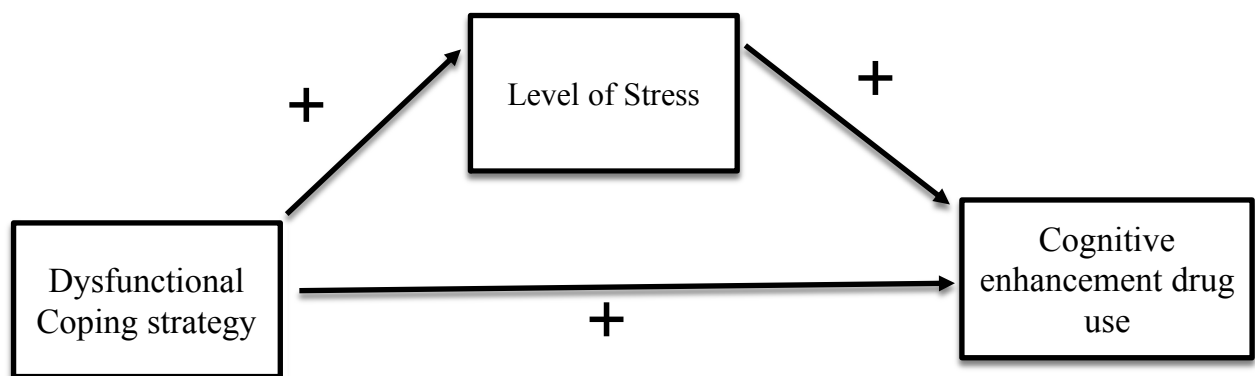


Figure 1. Level of stress as a mediator between dysfunctional coping and CE drug use.

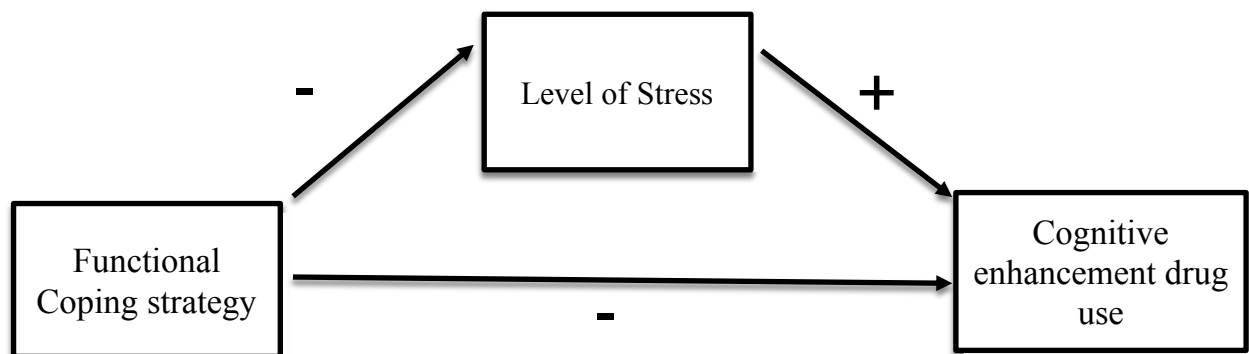


Figure 2. Level of stress as a mediator between functional coping and CE drug use.



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On the basis of the above mentioned, a research question can be formulated: **How does experienced stress mediate the relationship between different coping styles and cognitive enhancement drug use?**

In order to examine this research question, two hypotheses, with each two sub-hypotheses, are formulated:

- H1:**
- a.) **There is a positive relationship between dysfunctional coping and CE drug use.**
  - b.) **The relationship between dysfunctional coping and CE drug use is mediated by stress.**
- H2:**
- a.) **There is a negative relationship between functional coping and CE drug use.**
  - b.) **The relationship between functional coping and CE drug use is mediated by stress.**

### Methods

#### *Design*

By using a cross-sectional online-survey-based design, the relationship between the independent variable *coping*, the mediator *stress* and the dependent variable *CE drug use* was investigated. In total, six researchers were engaged in this study in order to investigate the relationship between CE drug use and different other variables.

#### *Participants*

A purposive sample ( $n = 270$ ) was gathered in order to test the established hypotheses. Participants were required to be at least 18 years old, to be student on university level and to have sufficient English skills in order to participate in this study. Also, respondents were required to fill in the entire questionnaire in order to be included in the dataset. The drop-out rate of participants due to the inclusion criteria was 35.2 %, which led to the final sample size ( $n = 175$ ).

Table 1 provides some socio-demographic characteristics of the respondents. The age of the participants varied from 18 to 30 years of age ( $M = 20.79$ ;  $SD = 2.42$ ). Most of the participants were female (72%), German (75.4 %), psychology students (74.3%) and in their first year of university (70.9%).

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Table 1

*Socio-demographic characteristics of the participants (N = 175).*

Item	Category	Frequency	Percentage
Gender	Male	48	27.4
	Female	126	72
	Other	1	0.6
Age	18-21	129	73.7
	22-25	35	20
	26-29	10	5.7
	30+	1	0.6
Nationality	German	132	75.4
	Dutch	22	12.6
	Others	21	12
Field of Study	Psychology	130	74.3
	Communication Science	28	16
	Other	17	9.7
Phase of Study	Year 1	124	70.9
	Year 2	17	9.7
	Year 3	17	9.7
	Year 4	10	5.7
	Year 5 +	8	4

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### ***Materials***

#### ***Demographics***

A self-constructed questionnaire about the demographics of the participants, such as gender, age, nationality, the field of study and the phase of the study they were in by the time the survey was conducted, was provided in order to gather general information on the characteristics of participants.

#### ***Cognitive enhancement drug use***

The variable *CE drug use* was measured with different sets of questions (see Appendix A). First, participants were asked to mark the different substances they used within the past 12 months. Lists of the substances were provided in three categories, as proposed by literature: (1) Over-the-counter drugs, (2) prescription drugs and (3) illicit drugs. As some substances fit in more than one category (e.g. cannabis fits in all three categories, depending on the way of how the participant got access to the substance), those substances were included in every category they could fit in. It was made sure that participants were aware of this distinction and the screening of the data indicated that the participants indeed made this distinction. The Over-the-counter drug category comprised, for example, substances such as caffeinated drinks, nicotine or legally bought cannabis, while the prescription drug category comprised substances such as  $\beta$ -blockers, modafinil and medical cannabis. The illicit drug category comprised substances such as cocaine, heroin and illegally-acquired cannabis.

Subsequently, participants were asked to indicate the frequency of the use of those substances. The frequencies of most substances were measured within the past 12 months, except for the frequencies of the use of nicotine and caffeinated drinks (within the past week) and the frequencies of the use of alcohol or legally bought cannabis (within the past month). All frequencies were measured on a 4-point Likert-scale (0 = 0 times within the past 12 months [or within the past week / the past month]; 3 = more than 10 times within the past 12 months [or within the past week / the past month]). In order to calculate a total and mean score for the three different categories, the frequencies of all substances were calculated for the past 12 months. The frequencies of the use of nicotine and caffeinated drinks were therefore multiplied by 52 and those of alcohol and legally bought cannabis by 12, in order to obtain

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the frequency within the past 12 months. Subsequently, a total score of the frequency of cognitive enhancement drug use within the past 12 months was calculated, by summing up the frequencies of the three different categories of cognitive enhancement drug use. An example item was: "*How often did you make use of Caffeine pills to enhance your cognitive performance in the past 12 months?*". In the present study, an overall acceptable reliability with  $\alpha = 0.71$  was found for the frequencies of total CE drug use, following the guideline which assumes an  $\alpha > 0,70$  to be acceptable (Tavakol & Dennick, 2011).

### ***Stress***

The variable *stress* was measured with the *Perceived Stress Scale* (PSS; Cohen, Kamarck & Mermelstein, 1983). This scale consists of ten items measuring the perceived general level of stress of the participants. The items were scored on a 5-point Likert-scale (0 = never; 4 = very often). The four items 4, 5, 7 and 8 were positively formulated and the scoring of the responses on those items was later reversed in order to sum up the scores of all items into a total score, which indicates the level of perceived stress. The PSS has a coefficient alpha reliability of .84, which indicates that it has a good internal consistency and a test-retest correlation of .85, which is considered to be a relatively good test-retest reliability (Cohen, Kamarck & Mermelstein, 1994). An adequate predictive and concurrent validity was found by Cohen et al. (1983) who created and validated the PSS. In the present study an acceptable reliability with  $\alpha = 0.91$  was found. An example item of the PSS is: "*In the last month, how often have you been upset because of something that happened unexpectedly?*"

### ***Coping***

The different *coping strategies* were measured with the *COPE Inventory* (Carver, 1997). This inventory consists of 60 items, measuring 15 specific coping behaviors: (1) *Positive reinterpretation and growth*, (2) *Mental disengagement*, (3) *Focus on and venting of emotions*, (4) *Use of instrumental social support*, (5) *Active coping*, (6) *Denial*, (7) *Religious coping*, (8) *Humour*, (9) *Behavioural disengagement*, (10) *Restraint*, (11) *Use of emotional social support*, (12) *Substance use*, (13) *Acceptance*, (14) *Suppression of competing activities* and (15) *Planning*. Each coping behaviour was measured with 4 items. Those items were scored on a 4-point Likert-scale (1 = I usually don't do this at all; 4 = I

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usually do this a lot). There is no total score resulting from the COPE Inventory, but standardized scores on the sub-scales of the different coping behaviours can be compared in order to make assumptions about more or less dominant coping behaviours in participants. According to Carver et al. (1989), most of the sub-scales can be divided into broader categories of coping.

*Dysfunctional coping* was measured with 12 items, which were obtained from the subscales *Mental disengagement*, *Focus on and venting of emotions* and *Behavioural disengagement*. An example item for *dysfunctional coping* is: “I turn to work or other substitute activities to take my mind off things”. Cooper, Katona and Livingston (2008) measured a coefficient alpha reliability of *dysfunctional coping* ( $\alpha = 0.75$ ), which indicates a good internal consistency for this scale. In the present study, the *dysfunctional coping* scale had an unacceptable Cronbach's alpha of 0.56.

*Functional coping* was measured with 40 items, which were obtained from the subscales *Positive reinterpretation and growth*, *Use of instrumental social support*, *Active coping*, *Denial*, *Religious coping*, *Restraint*, *Use of emotional social support*, *Acceptance*, *Suppression of competing activities* and *Planning*. An example item for functional coping is: “I try to get emotional support from friends or relatives”. Cooper et al. (2008) measured a coefficient alpha reliability of the two underlying subscales *problem-focused coping* ( $\alpha = 0.72$ ) and *emotion-focused coping* ( $\alpha = 0.84$ ), which indicate a good internal consistency. In the present study the *functional coping* scale had an acceptable Cronbach's alpha of 0.7.

The only two sub-scales that did not fit into the *dysfunctional/functional coping* construct are *humour* and *substance use*, which were not taken into account in the present study. The scores on *functional coping* and *dysfunctional coping* categories were computed as the mean scores of the underlying items of the sub-scales that form the broader categories. Also, regression analyses in the study by Cooper et al. (2008) indicated adequate convergent and concurrent validity of the *problem-focused*, *emotion-focused coping* and *dysfunctional coping* scales.

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### ***Procedure***

The ethical committee of the University of Twente approved this survey. The data collection took place between the 11th of April 2018 until the 27th of April 2018 through the distribution of an anonymous online link to the online Qualtrics questionnaire. The recruitment happened both via the *University of Twente SONA-reward System* and via the social-media appearances (e.g. Facebook) of the researchers, in order to get a sufficient sample size. Once participants clicked on the link, an introduction into the topic and an informed consent were presented. The informed consent contained information about the measurement of the different variables, the estimated study duration (ca. 30 minutes), the possibility to withdraw at any time of the study, the participant's anonymity and email addresses of the researchers. Subsequently, participants filled in the survey. At the end of the study, acknowledgements and a possibility to either hand in the own email address in order to get information about the results of the study or to contact the researchers for further questions were provided.

### ***Analysis***

In order to adequately answer the research question, „*How does experienced stress mediate the relationship between different coping styles and cognitive enhancement drug use?*“, several analyses will be conducted.

Firstly, descriptive statistics will be computed. For each variable (*stress*, *coping* and *CE drug use*) mean-scores, standard deviations, Skewness and Kurtosis will be calculated. For Skewness as well as Kurtosis +1 and -1 will be set as cut-off scores. Additionally, for every variable, the Cronbach's Alpha coefficients will be investigated. An Alpha value of  $\alpha > 0,70$  is assumed to be acceptable (Tavakol & Dennick, 2011). Also, correlations between all variables will be computed in order to get a first impression of the relation between those variables. In order to verify whether *problem-focused coping* and *emotion-focused coping* indeed have an underlying *functional coping* component, a correlation between both variables will be conducted. Lastly, the analysis of the mediation model will be conducted in SPSS via a set of regression analyses, as proposed by Preacher and Hayes (2004). The PROCESS macro for SPSS (Hayes, 2012) will be used for linear regression models in order to determine whether *stress* was functioning as a mediator in the relationship between *coping* and *CE drug use*.

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As there are two different independent variables, the PROCESS macro will be used twice, first with dysfunctional coping as independent variable in order to test H1a and H1b and later with functional coping as independent variable in order to test H2a and H2b. The PROCESS macro approaches mediation by means of bootstrap confidence intervals, as this approach is seen as an advantageous method in the case of a non-normality of the distribution of the sample (Hayes, 2012). If the bootstrap confidence interval does not include zero, the mediation is seen as statistically significant.



### Results

#### *Descriptive statistics of the coping, stress and CE drug use scales*

Means, Standard Deviations and Min/Max values were determined for the descriptive statistics (Table 2). The Cronbach's Alpha coefficients for the scales *functional coping*, *stress* and *total CE drug use* were acceptable, according to the guideline for a Cronbach's Alpha value of  $\alpha > 0.70$  (Tavakol & Dennick, 2011). The Cronbach's Alpha coefficient of the *dysfunctional coping* scale was below 0.70 and therefore not acceptable.

In order to test the normality of the scales, Skewness and Kurtosis were calculated. As the Skewness and Kurtosis scores of the scales *stress* and *CE drug use* lie between the interval of +1 to -1 they were interpreted as normally distributed. As the Skewness and Kurtosis scores of the functional and dysfunctional coping scales did not lie within the interval between +1 and -1, they were interpreted as non-normally distributed.

In order to screen for direct effects between the variables, Spearman correlations of the scales were conducted, as this approach pre-assumes non-normally distributed data. There was a moderate, positive and statistically significant correlation between *dysfunctional coping* and *stress* ( $r = 0.43$ ;  $p < .001$ ). Also, a weak, negative and statistically significant correlation was found between *functional coping* and *stress* ( $r = -0.2$ ;  $p = 0.008$ ). Therefore, *dysfunctional coping* seemed to have a positive relationship with *stress*, while *functional coping* seemed to have a negative relationship with *stress*.

Also, a Spearman correlation between *problem-focused coping* and *emotion-focused coping* was conducted, in order to check if there is indeed an underlying *functional coping* component. As the correlation indicated a statistically significant positive relationship between both variables ( $r = 0.574$ ;  $p < 0.01$ ), the assumption of an underlying functional component was supported and adapted in the analyses.

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Table 2

*Descriptive statistics of the coping, stress and CE drug use scales.*

<i>Item</i>	<i>Mean (SD)</i>	<i>Min</i>	<i>Max</i>	<i>Skew- ness</i>	<i>Kurto- sis</i>	<i>α</i>	<i>Dys- func- tional coping</i>	<i>Func- tional coping</i>	<i>Stress</i>
Dysfunc- tional Coping	8.78 (1.75)	4.67	15	0.513	1.113	0.56	-	-	-
Func- tional Coping	10.05 (1.37)	6.10	15.2	0.465	1.627	0.7	0,125	-	-
Stress	18.66 (7)	2	34	0.059	-0.401	0.91	0.43 **	-0.2 **	-
Frequency of CE drug use (within past 12 months)	143.65 (127.19)	0	474	0.764	-0.277	0.71	0.063	-0.098	0.089

**\*\* Correlation is significant at the 0.01 level (2-tailed).**

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### *Mediation Analyses*

A series of linear regression models were fitted in order to test hypothesis H1a, which states that there is a positive relationship between dysfunctional coping and CE drug use, and hypothesis H1b, which states that the relationship in H1a is mediated by stress (Table 3). In the first step of the mediation model, the regression of dysfunctional coping on total CE drug use, not taking into account the mediator, was non-significant,  $b = 2.4$ ,  $SE = 5.54$ ,  $p = 0.67$ . The second step showed that the regression of dysfunctional coping on the mediator, stress, was significant,  $b = 1.88$ ,  $SE = 0.27$ ,  $p < 0.001$ . The third step of the mediation process indicated that the mediator (stress), controlling for dysfunctional coping, was non-significant,  $b = 1.53$ ,  $SE = 1.56$ ,  $p = 0.33$ . The fourth step of the analysis showed that, controlling for the mediator (stress), dysfunctional coping was not a significant predictor of total CE drug use,  $b = -0.47$ ,  $SE = 6.27$ ,  $p = 0.94$ . The last step of the analysis comprised bootstrap confidence intervals with 5.000 samples in order to test the indirect effect. The results indicated no indirect effect, as zero is included in the confidence interval  $b = 2.87$ ,  $SE = 2.93$ , 95% CI = [-2.69; 8.81].

Thus, hypothesis H1a, which assumes a positive relationship between dysfunctional coping and CE drug use, is not supported. Therefore, dysfunctional coping seems not to be related to CE drug use in the present study. Also, hypothesis H1b, which assumes stress to be mediating the relationship between dysfunctional coping and CE drug use, is not supported. Stress seems to be positively related to dysfunctional coping, while it does not seem to be related to CE drug use in the present study.

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Table 3

*The indirect effect of stress on the relationship between dysfunctional coping and total CE drug use.*

<i>Step 1: Outcome: CE drug use</i>						
	<i>b</i>	<i>SE</i>	<i>t</i>	<i>p</i>	<i>LLCI</i>	<i>ULCI</i>
<i>Dysfunctional coping</i>	2.4	5.54	0.43	0.67	- 8.54	13.33
<i>Model</i>	<i>R</i> <sup>2</sup>		<i>F</i>	<i>p</i>		
	0.001		0.19	0.67		
<i>Step 2: Outcome: Stress</i>						
	<i>b</i>	<i>SE</i>	<i>t</i>	<i>p</i>	<i>LLCI</i>	<i>ULCI</i>
<i>Dysfunctional coping</i>	1.88	0.27	6.96	0.00	1.35	2.41
<i>Model</i>	<i>R</i> <sup>2</sup>		<i>F</i>	<i>p</i>		
	0.22		48.48	0.00		
<i>Step 3 + 4: Outcome: CE drug use</i>						
	<i>b</i>	<i>SE</i>	<i>t</i>	<i>p</i>	<i>LLCI</i>	<i>ULCI</i>
<i>Dysfunctional coping</i>	- 0.47	6.27	-0.08	0.94	-12.85	11.9
<i>Stress</i>	1.53	1.56	0.98	0.33	-1.56	4.61
<i>Model</i>	<i>R</i> <sup>2</sup>		<i>F</i>	<i>p</i>		
	0.007		0.58	0.57		
<i>Indirect Effect</i>						
	<i>b</i>	<i>BootSE</i>			<i>Boot-LLCI</i>	<i>BootULCI</i>
<i>Stress</i>	2.87	2.93			- 2.96	8.81

*Note.* *b* = unstandardized regression coefficient.

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Also, a series of linear regression models were fitted in order to test hypothesis H2a, which states that there is a negative relationship between functional coping and CE drug use, and H2b, which states that the relationship in H2a is mediated by stress (Table 4). In the first step of the mediation model, the regression of functional coping on total CE drug use, not taking into account the mediator, was non-significant,  $b = -11.1$ ,  $SE = 6.99$ ,  $p = 0.11$ . The second step showed that the regression of functional coping on the mediator, stress, was non-significant,  $b = -0.39$ ,  $SE = 0.39$ ,  $p = 0.32$ . The third step of the mediation process indicated that the mediator (stress), controlling for functional coping, was non-significant,  $b = 1.32$ ,  $SE = 1.38$ ,  $p = 0.34$ . The fourth step of the analysis showed that, controlling for the mediator (stress), functional coping was not a significant predictor of total CE drug use,  $b = -10.6$ ,  $SE = 1$ ,  $p = 0.13$ . The last step of the analysis comprised bootstrap confidence intervals with 5.000 samples in order to test the indirect effect. The results indicated no indirect effect, as zero is included in the confidence interval  $b = -0.51$ ,  $SE = 1.37$ , 95% CI = [-4.18; 1.43].

Thus, hypothesis H2a, which assumes a negative relationship between functional coping and CE drug use, is not supported. Therefore, functional coping seems not be related to CE drug use in the present study. Also, hypothesis H2b, which assumes stress to be mediating the relationship between functional coping and CE drug use, is not supported. Therefore, the present study assumes that stress is not related to CE drug use and also not to functional coping.

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Table 4

*The indirect effect of stress on the relationship between functional coping and total CE drug use.*

<i>Step 1: Outcome: CE drug use</i>						
	<i>b</i>	<i>SE</i>	<i>t</i>	<i>p</i>	<i>LLCI</i>	<i>ULCI</i>
<i>Functional coping</i>	-11.1	6.99	-1.59	0.11	- 24.9	2.7
	<i>R<sup>2</sup></i>		<i>F</i>	<i>p</i>		
<i>Model</i>	0.014		2.52	0.11		
<i>Step 2: Outcome: Stress</i>						
	<i>b</i>	<i>SE</i>	<i>t</i>	<i>p</i>	<i>LLCI</i>	<i>ULCI</i>
<i>Functional coping</i>	-0.39	0.39	-1	0.32	-1.15	0.38
	<i>R<sup>2</sup></i>		<i>F</i>	<i>p</i>		
<i>Model</i>	0.006		0.99	0.32		
<i>Step 3 + 4: Outcome: CE drug use</i>						
	<i>b</i>	<i>SE</i>	<i>t</i>	<i>p</i>	<i>LLCI</i>	<i>ULCI</i>
<i>Functional coping</i>	-10.6	1	-1.51	0.13	-24.44	3.25
<i>Stress</i>	1.32	1.38	0.96	0.34	-1.4	4.03
	<i>R<sup>2</sup></i>		<i>F</i>	<i>p</i>		
<i>Model</i>	0.019		1.72	0.18		
<i>Indirect Effect</i>						
	<i>b</i>	<i>BootSE</i>			<i>Boot-LLCI</i>	<i>BootULCI</i>
<i>Stress</i>	-0.51	1.37			-4.18	1.43

*Note.* *b* = unstandardized regression coefficient.

### Discussion

In order to gain a deeper understanding of the relationship between different coping styles and the frequency of CE drug use, the following research question was formulated: *How does experienced stress mediate the relationship between different coping styles and cognitive enhancement drug use?*

In the present study, there is no relationship found between dysfunctional coping and CE drug use. Therefore, dysfunctional coping behaviours do not seem to be a risk factor for CE drug use in university students. This is not in line with the literature about that topic, as Riddell et al. (2017) found out that dysfunctional coping strategies increase the likelihood of CE drug use in an Australian university-student sample.

As there was no relationship found between dysfunctional coping and CE drug use, stress could not mediate this relationship. This is partly in line with literature, as the relationship between dysfunctional coping and stress in the present study was also assumed in previous research on that topic (Lazarus & Folkman, 1984). Therefore, the present study provides evidence for the assumption that dysfunctional coping leads to an increased level of stress. Not in line with literature is the absence of a relationship between stress and CE drug use in the present study, as previous research indicated that there is a positive relationship between stress and CE drug use (Franke et al., 2013; Sinha, 2001; Maier et al., 2013). Therefore, stress does not seem to be a risk factor for CE drug use in the present study.

Also, there is no relationship found between functional coping and CE drug use. Therefore, functional coping behaviours do not seem to be a protective factor for CE drug use in university students. This is not in line with the literature on that topic, as Jensen et al. (2016) assumed that functional coping decreases the likelihood of CE drug use behaviours.

As there was no relationship found between functional coping and CE drug use, stress could not mediate this relationship. This is not in line with literature, as Jensen et al. (2016) found out, that students with more realistic and functional coping strategies are more likely to maintain a manageable stress-level. Therefore, functional coping strategies do not seem to be a protective factor for stress in the present study. Also, not in line with literature is the absence of a relationship between stress and CE drug use in the present study. Previously, stress was found to have a positive relationship with CE drug

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use (Franke et al., 2013; Sinha, 2001; Maier et al., 2013), which is not supported by the results of the present study.

As the present study could not provide proof for both, a relationship between dysfunctional coping and CE drug use and a relationship between functional coping and CE drug use, the reasons for this might be of more fundamental origin, rather than due to the two specific coping styles.

A possible explanation for this could be cross-cultural differences in reasons to engage in CE drug use behaviours, as the sample of the current study mainly comprised German (75.4%) and Dutch (12.6%) students, while research that found relationships between dysfunctional coping and CE drug use and functional coping and CE drug use was conducted in Australian university samples (Riddell et al., 2017; Jensen et al., 2016). Research that examined the main reasons why students use CE drugs in a German student sample, lead to the assumption that CE behaviours do not depend on personal skills, such as coping strategies (Mache, Eickenhorst, Vitzthum, Klapp & Groneberg, 2012). The difference in the relationship between coping and CE drug use between German and Australian students might be explained by the cross-cultural differences in coping behaviours. Frydenberg et al. (2003) found out that there are cross-cultural differences in coping behaviours which need to be accounted for, when adapting coping patterns from one nation to another. Even though, coping strategies between German and Australian students seemed to be most similar, compared to coping strategies used by Palestine and Colombian students, there still were differences in coping. German students reported that they more frequently made use of *professional help*, compared to Australians, which might prevent them from CE drug use, as literature indicates that people that make use of professional help are less likely to engage in drug use behaviours (Ouimette, Finney & Moos, 1997; Rickwood, Deane & Wilson, 2007). Also, Australians reported more frequent use of the coping strategies *keep to self* and *work hard*, compared to Germans. This might encourage them to participate in CE drug use, as previous literature showed that persons that make use of non-productive coping strategies, which include the coping strategy *keep to self*, are more often engaging in substance use (Snow & Bruce, 2003). For German students, it is possible that other variables are more likely to have an influence on CE drug use. Peer pressure was found to be the main reason for engaging in CE drug use behaviours (Mache et al., 2012). A possible explanation for this could be, that German students have inaccurate perceptions of substance use of



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their peers. The consumption of CE drugs by peers can influence students to take the same substances, even though no other risk factors, such as the need for CE in order to improve academic performance, might be applicable for the student. Additional risk factors for German students for CE drug use include academic failure and poor social skills (Mache et al., 2012).

Another possible explanation for the non-existence of the relationship between coping and CE drug use in the present study, compared to the existence of such a relationship in an Australian student sample, might be, that there are differences in the prevalences for CE drug use: In a German student sample, the lifetime prevalence of CE drug use was found to be 1.3% (Franke et al., 2011), while the lifetime prevalence of CE drug use in an Australian student sample was found to be 10% (Mazanov, Dunn, Conor & Fielding, 2013). It is possible, that the relationship between coping and CE drug use was not present in the current study, because of the low prevalence rate for German students. Due to this low prevalence rate for German students, it is possible that the scores on the CE drug use scale in the present study did not offer enough variation in order to establish a statistically significant relationship between coping and CE drug use. The low prevalence rate for German students, and therefore the possible low variance of the scores of the CE drug use scale, might also explain the non-existence of the relationship between stress and CE drug use in the current study.

### ***Strengths, Limitations & Recommendations***

A strength of this study is, that it is the first study that tries to examine the relationship between coping and CE drug use in a European sample. So far, research on the relationship between those two variables was conducted in Australian student samples (Riddell et al., 2017; Jensen et al., 2016). Those studies conducted in Australian samples provide evidence for the existences of a relationship between coping styles and CE drug use, while the results of a study conducted in a German student sample assume personal skills, such as coping strategies, not be associated with CE drug use (Mache et al., 2012). Due to this, the present study provides evidence for cross-cultural differences in the relationship between coping and CE drug use.

Another strength of this study is, that this research forms the first attempt to get a deeper understanding of the relationship between coping and CE drug use. Research so far only focused on the

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relationship between coping and CE drug use (Riddell et al., 2017; Jensen et al., 2016), but did not take into account possibly underlying variables, such as stress. Due to this, the present study not only provides evidence for the non-existence of a relationship between coping styles and CE drug use but also that stress has not a mediating effect on that relationship.

Additionally, this study forms the first attempt to differentiate between dysfunctional and functional coping styles, while previous research mainly focused on the distinction between dysfunctional coping, emotion-focused coping and problem-focused coping (Riddell et al., 2017; Jensen et al., 2016). As the present study did not indicate a negative relationship between functional coping and stress, future research is needed in order to approve or disapprove the usage of the functional coping scale in order to measure coping styles that are effective in reducing stress.

In order to adequately interpret the results, the following limitations should be taken into account. Firstly, the study was conducted in a cross-sectional setting. Due to this, no inferences about the causality of relationships can be made. It is, for example, assumed that dysfunctional coping leads to an increase in the level of stress a person is experiencing. In fact, it is possible, that the amount of stress influences the choice and adaption of which coping style is used in order to deal with that stress. Therefore, the above-mentioned results and the interpretation of the results need to be interpreted carefully. An implication for future research is, therefore, that it might be useful to assess the current research model in a longitudinal design, in order to make assumptions about the causality of the existing relationships.

Secondly, the variable CE drug use was computed by means of summing up the frequencies of the used substances. Some substance use frequencies were measured in a weekly time frame (e.g. nicotine) or in a monthly time frame (e.g. legally bought cannabis), while the majority of the substance use frequencies was measured in a yearly time frame (e.g.  $\beta$ -blocker). Therefore, the frequencies of substance use in the smaller time frames needed to be multiplied by 12 (for the monthly time frame) or by 52 (for the weekly time frame) in order to obtain comparable frequency scores. As the answer categories on the Likert-scale for the frequency of substance use were divided into intervals (e.g. 1 = 1 - 3 times in the past week), those intervals got linearly bigger when multiplied by the factor to obtain yearly frequencies. Therefore, it is possible that if a participant stated to have used nicotine only once within

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the past week, the calculated yearly frequency would be between 52 and 156. Therefore, the representativeness of those scores might be inaccurate due to multiplying them, which might have influenced the reliability of this scale. An implication for future research is, that the frequency of use of all substances might better be measured in conform time frames, then in different time frames for different variables, in order to get more accurate and representative frequency scores.

Thirdly, the present research made solely use of subjective self-report measures. This is especially important for the measured frequency of CE substances. Social desirability response biases in participants that engaged in drug use behaviours, can have an influence on the reported frequency scores (Van de Mortel, 2008). Literature shows that participants generally underestimated their substance use, in order to conform to social norms or values (McGilloway & Donnelly, 2004; Friedman, Terras, Zhu & McCallum et, 2004). Therefore, it could be possible that the self-reported scores on the CE drug use scale are not as representative for the actual CE drug consumption as assumed. An implication for future research might be, that it should try to take biases, such as the social desirability bias, into account, when dealing with self-reported substance use frequencies. There are several validated scales that can be used to detect social desirability biases in surveys. The most widely used scale is the Marlowe-Crowne Desirability Scale (MCSDS), in which participants answer with true or false to socially desirable but improbable items (King & Bruner, 2000; Crowne & Marlowe, 1960). Partial correlations or hierarchical stepwise regression analysis could then be used in order to correct for those biases, as well as SPSS software packages that enable researchers to investigate relationships between two variables while accounting for social desirability response biases (King & Bruner, 2000; Pallant, 2013).

### ***Conclusion***

This study investigated the relationship between coping, stress and CE drug use. In the current study, which was conducted in a student sample consisting of mostly German or Dutch students, coping seemed not to be related to CE drug use, while research conducted in Australian samples provided prove for the existence of a relationship between coping and CE drug use (Riddell et al., 2017; Jensen et al., 2016). It is assumed that cross-cultural differences in coping behaviours might be accountable for this difference, as German students more often make use of professional help in order to deal with stress,

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compared to Australian students (Frydenberg et al., 2003). Personal skills such as coping might therefore not be a predictor of CE drug use for German students, as also assumed by Mache et al. (2012). An implication for future research might be to focus more on interpersonal skills or attitudes that might predict CE drug use in order to investigate possible risk factors, as it is assumed that peer pressure or poor social skills might lead to CE drug use in German students (Mache et al., 2012). As cognitive enhancement by means of substance abuse is associated with great physical and psychological health risks (Weyandt et al., 2009; Leshner, 1997; Qureshi et al., 2001), it is important to further elaborate on possible culture-specific CE drug use risk factors to prevent people from those harmful consequences.

## RELATIONSHIP BETWEEN COPING, STRESS AND CE DRUG USE

### References:

- Bostrom, N., & Sandberg, A. (2009). Cognitive enhancement: methods, ethics, regulatory challenges. *Science and engineering ethics*, 15(3), 311-341.
- Bright, G. M. (2008). Abuse of medications employed for the treatment of ADHD: results from a large-scale community survey. *The Medscape Journal of Medicine*, 10(5), 111.
- Carver, C. S. (1997). You want to measure coping but your protocol's too long: Consider the brief cope. *International journal of behavioral medicine*, 4(1), 92.
- Carver, C. S., Scheier, M. F., & Weintraub, J. K. (1989). Assessing coping strategies: a theoretically based approach. *Journal of personality and social psychology*, 56(2), 267.
- Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of health and social behavior*, 385-396.
- Cohen, S., Kamarck, T., & Mermelstein, R. (1994). Perceived stress scale. Measuring stress: A guide for health and social scientists.
- Collins, G. B., & McAllister, M. S. (2006). Combating abuse and diversion of prescription opiate medications. *Psychiatric Annals*, 36(6), 410.
- Compton, W. M., & Volkow, N. D. (2006). Abuse of prescription drugs and the risk of addiction. *Drug & Alcohol Dependence*, 83, S4-S7.
- Cooper, C., Katona, C., & Livingston, G. (2008). Validity and reliability of the brief COPE in carers of people with dementia: the LASER-AD Study. *The Journal of nervous and mental disease*, 196(11), 838-843.

## RELATIONSHIP BETWEEN COPING, STRESS AND CE DRUG USE

- Crowne, D. P., & Marlowe, D. (1960). A new scale of social desirability independent of psychopathology. *Journal of consulting psychology*, 24(4), 349.
- Farah, M. J., Haimm, C., Sankoorikal, G., & Chatterjee, A. (2009). When we enhance cognition with Adderall, do we sacrifice creativity? A preliminary study. *Psychopharmacology*, 202(1-3), 541-547.
- Farah, M. J., Illes, J., Cook-Deegan, R., Gardner, H., Kandel, E., King, P., & Wolpe, P. R. (2004). Neurocognitive enhancement: what can we do and what should we do? *Nature reviews neuroscience*, 5(5), 421.
- Folkman, S., & Lazarus, R. S. (1980). An analysis of coping in a middle-aged community sample. *Journal of health and social behavior*, 219-239.
- Forlini, C., & Racine, E. (2009). Autonomy and coercion in academic “cognitive enhancement” using methylphenidate: Perspectives of key stakeholders. *Neuroethics*, 2(3), 163-177.
- Franke, A. G., Bagusat, C., Dietz, P., Hoffmann, I., Simon, P., Ulrich, R., & Lieb, K. (2013). Use of illicit and prescription drugs for cognitive or mood enhancement among surgeons. *BMC medicine*, 11(1), 102.
- Franke, A. G., Bonertz, C., Christmann, M., Huss, M., Fellgiebel, A., Hildt, E., & Lieb, K. (2011). Non-medical use of prescription stimulants and illicit use of stimulants for cognitive enhancement in pupils and students in Germany. *Pharmacopsychiatry*, 44(2), 60.

## RELATIONSHIP BETWEEN COPING, STRESS AND CE DRUG USE

- Friedman, A. S., Terras, A., Zhu, W., & McCallum, J. (2004). Depression, negative self-image, and suicidal attempts as effects of substance use and substance dependence. *Journal of Addictive Diseases*, 23(4), 55-71.
- Frydenberg, E., Lewis, R., Kennedy, G., Ardila, R., Frindte, W., & Hannoun, R. (2003). Coping with concerns: An exploratory comparison of Australian, Colombian, German and Palestinian adolescents. *Journal of Youth and Adolescence*, 32, 59 – 66.
- Gowing, L. R., Henry-Edwards, S. M., Irvine, R. J., & Ali, R. L. (2002). The health effects of ecstasy: a literature review. *Drug and Alcohol Review*, 21(1), 53-63.
- Grady, C. L. (2008). Cognitive neuroscience of aging. *Annals of the New York Academy of Sciences*, 1124(1), 127-144.
- Gulpinar, M., & Yegen, B. (2004). The physiology of learning and memory: role of peptides and stress. *Current Protein and Peptide Science*, 5(6), 457-473.
- Hayes, A. F. (2012). PROCESS: A versatile computational tool for observed variable mediation, moderation, and conditional process modeling. Retrieved from <http://www.afhayes.com/public/process2012.pdf>
- Jensen, C., Forlini, C., Partridge, B., & Hall, W. (2016). Australian University Students' Coping Strategies and Use of Pharmaceutical Stimulants as Cognitive Enhancers. *Frontiers in Psychology*, 7(277). doi:10.3389/fpsyg.2016.00277
- King, M. F., & Bruner, G. C. (2000). Social desirability bias: A neglected aspect of validity testing. *Psychology and Marketing*, 17(2), 79-103.

## RELATIONSHIP BETWEEN COPING, STRESS AND CE DRUG USE

- Lazarus, R. S., & Folkman, S. (1984). Stress, appraisal and coping. *Springer Publishing Company*.
- Lee, E., & Ma, Y. (1995). Amphetamine enhances memory retention and facilitates norepinephrine release from the hippocampus in rats. *Brain research bulletin*, 37(4), 411-416.
- Leshner, A. I. (1997). Addiction is a brain disease, and it matters. *Science*, 278(5335), 45-47.
- Lessenger, J. E., & Feinberg, S. D. (2008). Abuse of prescription and over-the-counter medications. *The Journal of the American Board of Family Medicine*, 21(1), 45-54.
- Mache, S., Eickenhorst, P., Vitzthum, K., Klapp, B. F., & Groneberg, D. A. (2012). Cognitive enhancing substance use at German universities: frequency, reasons and gender differences. *Wiener Medizinische Wochenschrift*, 162(11), 262-271. doi:10.1007/s10354-012-0115-y
- Maier, L. J., Liechti, M. E., Herzig, F., & Schaub, M. P. (2013). To dope or not to dope: neuroenhancement with prescription drugs and drugs of abuse among Swiss university students. *PLoS One*, 8(11), e77967.
- Mazanov, J., Dunn, M., Connor, J., & Fielding, M.-L. (2013). Substance use to enhance academic performance among Australian university students. *Performance Enhancement & Health*, 2(3), 110-118. doi:<https://doi.org/10.1016/j.peh.2013.08.017>
- McGilloway, S., & Donnelly, M. (2004). Mental illness in the UK criminal justice system: a police liaison scheme for mentally disordered offenders in Belfast. *Journal of mental health*, 13(3), 263-275.
- Meikle, A., Riby, L. M., & Stollery, B. (2005). Memory processing and the glucose facilitation effect: the effects of stimulus difficulty and memory load. *Nutritional Neuroscience*, 8(4), 227-232.



## RELATIONSHIP BETWEEN COPING, STRESS AND CE DRUG USE

- Ouimette, P. C., Finney, J. W., & Moos, R. H. (1997). Twelve-step and cognitive-behavioral treatment for substance abuse: A comparison of treatment effectiveness. *Journal of consulting and clinical psychology*, 65(2), 230.
- Pallant, J. (2013). SPSS survival manual. *McGraw-Hill Education* (UK).
- Patton, G. C., Coffey, C., Carlin, J. B., Degenhardt, L., Lynskey, M., & Hall, W. (2002). Cannabis use and mental health in young people: cohort study. *Bmj*, 325(7374), 1195-1198.
- Peterkin, A. L., Crone, C. C., Sheridan, M. J., & Wise, T. N. (2011). Cognitive performance enhancement: misuse or self-treatment? *Journal of Attention Disorders*, 15(4), 263-268.
- Preacher, K. J., & Hayes, A. F. (2004). SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behavior research methods, instruments, & computers*, 36(4), 717-731.
- Qureshi, A. I., Suri, M. F. K., Guterman, L. R., & Hopkins, L. N. (2001). Cocaine use and the likelihood of nonfatal myocardial infarction and stroke: data from the Third National Health and Nutrition Examination Survey. *Circulation*, 103(4), 502-506.
- Rabiner, D. L., Anastopoulos, A. D., Costello, E. J., Hoyle, R. H., McCabe, S. E., & Swartzwelder, H. S. (2009). Motives and perceived consequences of nonmedical ADHD medication use by college students: are students treating themselves for attention problems? *Journal of Attention Disorders*, 13(3), 259-270.
- Rezvani, A. H., & Levin, E. D. (2001). Cognitive effects of nicotine. *Biological psychiatry*, 49(3), 258-267.

## RELATIONSHIP BETWEEN COPING, STRESS AND CE DRUG USE

- Rickwood, D. J., Deane, F. P., & Wilson, C. J. (2007). When and how do young people seek professional help for mental health problems?. *Medical Journal of Australia*, 187(7), S35.
- Riddell, C., Jensen, C., & Carter, O. (2017). Cognitive Enhancement and Coping in an Australian University Student Sample. *Journal of Cognitive Enhancement*, 1-7.
- Roger, V. L., Go, A. S., Lloyd-Jones, D. M., Adams, R. J., Berry, J. D., Brown, T. M. & Ford, E. S. (2011). Heart disease and stroke statistics - 2011 update: a report from the American Heart Association. *Circulation*, 123(4), e18.
- Sinha, R. (2001). How does stress increase risk of drug abuse and relapse? *Psychopharmacology*, 158(4), 343-359.
- Snow, P. C., & Bruce, D. D. (2003). Cigarette smoking in teenage girls: exploring the role of peer reputations, self-concept and coping. *Health Education Research*, 18(4), 439-452.
- Soetens, E., Hueting, J., Casaer, S., & D'Hooze, R. (1995). Effect of amphetamine on long-term retention of verbal material. *Psychopharmacology*, 119(2), 155-162.
- Solomon, P. R., Adams, F., Silver, A., Zimmer, J., & DeVeaux, R. (2002). Ginkgo for memory enhancement: a randomized controlled trial. *Jama*, 288(7), 835-840.
- Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. *International Journal of Medical Education*, 2(1), 53-55. doi:10.5116/ijme.4dfb.8dfd
- Van de Mortel, T. F. (2008). Faking it: social desirability response bias in self-report research. *Australian Journal of Advanced Nursing*, 25(4), 40.

## RELATIONSHIP BETWEEN COPING, STRESS AND CE DRUG USE

Wilens, T. E., Adler, L. A., Adams, J., Sgambati, S., Rotrosen, J., Sawtelle, R., & Fusillo, S.

(2008). Misuse and diversion of stimulants prescribed for ADHD: a systematic review of the literature. *Journal of the American Academy of Child & Adolescent Psychiatry*, 47(1), 21-31.

Yuen, E. Y., Wei, J., Liu, W., Zhong, P., Li, X., & Yan, Z. (2012). Repeated stress causes cognitive impairment by suppressing glutamate receptor expression and function in prefrontal cortex. *Neuron*, 73(5), 962-977.

**Appendices:**

***Appendix A: CE drug use questionnaire***

First of all, we would like to give you a definition of cognitive enhancement drugs. Cognitive enhancement drugs are psychoactive drugs that are used to increase one's cognitive performance. This includes improving memory, vigilance, attention and concentration within healthy individuals, who have no prescription for these drugs. Regarding the various substances used for this purpose a distinction can be made between three categories:

- 1) 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.
- 2) Prescription drugs initially designed for the treatment of disorders like ADHD or sleep disorders that are being misused for cognitive enhancement. Examples are Methylphenidate (e.g. Ritalin) or Modafinil.
- 3) Illicit drugs like ecstasy or methamphetamine that are mainly used for recreational purposes but also enhance cognition.

Have you ever made use of a substance (one mentioned above or another) to increase your cognitive performance?

☐ Yes

☐ No

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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 of for cognitive enhancement?

- ☐ Caffeine pills
- ☐ Caffeinated drinks (e.g. coffee, energy drinks)
- ☐ Cigarettes/Nicotine
- ☐ Alcohol
- ☐ Cannabis/Marijuana (legally bought)
- ☐ Other: \_\_\_\_\_
- ☐ None

How often did you make use of Caffeine pills to enhance your cognitive performance in the past 12 months?

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

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

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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

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

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

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

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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 of 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

How often did you make use of Methylphenidate (e.g. Ritalin, Concerta) to enhance your cognitive performance in the past 12 months?

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

## RELATIONSHIP BETWEEN COPING, STRESS AND CE DRUG USE

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

How often did you make use of  $\beta$ -Blocker (e.g. Beloc) to enhance your cognitive performance in the past 12 months?

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

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

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



## RELATIONSHIP BETWEEN COPING, STRESS AND CE DRUG USE

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

How often did you make use of Cannabis/Marijuana to enhance your cognitive performance in the past 12 months?

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

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

## RELATIONSHIP BETWEEN COPING, STRESS AND CE DRUG USE

What Illicit drugs (like ecstasy or methamphetamine that are mainly used for recreational purposes but also enhance cognition) did you make use of for cognitive enhancement?

- ☐ Amphetamine (e.g. Speed/Pep)
- ☐ Cocaine
- ☐ Methylenedioxymethamphetamine/MDMA (Ecstasy)
- ☐ Cannabis/Marijuana (illicitly bought)
- ☐ Heroin
- ☐ Other: \_\_\_\_\_
- ☐ None

How often did you make use of Amphetamine (e.g. Speed/Pep) to enhance your cognitive performance in the past 12 months?

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

How often did you make use of Cocaine to enhance your cognitive performance in the past 12 months?

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

## RELATIONSHIP BETWEEN COPING, STRESS AND CE DRUG USE

How often did you make use of Methylenedioxymethamphetamine/MDMA (Ecstasy) to enhance your cognitive performance in the past 12 months?

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

How often did you make use of illicit Cannabis/Marijuana to enhance your cognitive performance in the past 12 months?

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

How often did you make use of Heroin to enhance your cognitive performance in the past 12 months?

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

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