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## Accepted Manuscript

Title: Personal and perceived peer use and attitudes towards the use of nonmedical prescription stimulants to improve academic performance among university students in seven European countries

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**Personal and perceived peer use and attitudes towards the use of nonmedical prescription stimulants to improve academic performance among university students in seven European countries**

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#### Highlights

- Students' nonmedical use of prescription stimulants (NMUPS) varied across Europe.
- Personal approval of NMUPS was high among European university students.
- Students perceived the peer NMUPS to be higher than their personal use.
- Perceived peer use was associated with higher personal use of NMUPS.

**ABSTRACT**

Background: Overestimations of non-prescribed stimulant use of peers are well documented in the U.S.A. and have also been identified as predictive of personal stimulant consumption. This study aimed to examine whether overestimations of peer use and approval of the use are associated with personal use and attitude towards the use of non-prescribed stimulants among European university students. Method: The EU funded 'Social Norms Intervention for the prevention of Polydrug use (SNIPE)' study was conducted in seven European countries. In a web-based questionnaire, 4,482 students were asked about their personal use and their attitude towards non-prescribed stimulant use, as well as the perceived peer use and peer attitude. Results: 59% of students thought that the majority of their peers used non-prescribed stimulants more frequently than themselves, and only 4% thought that the use of the majority was lower than their personal use. The perception that the majority of peers had used non-prescribed stimulants at least once was significantly associated with higher odds for personal use of non-prescribed stimulants (OR: 3.30, 95% CI: 2.32-4.71). In addition, the perception that the majority of peers approved of the non-prescribed use of stimulants was associated with a 4.03 (95% CI: 3.35-4.84) times higher likelihood for personal approval. Discussion: European university students generally perceived the non-prescribed use of stimulants of peers to be higher than their personal use. This perception, as well as a perception of higher approval in the peer group, was associated with a higher likelihood of personal non-prescribed stimulant medication use and approval.

**KEYWORDS:** prescription stimulant, nonmedical use, non-prescribed, university students, misperceptions, social norms

**Final trial registration number:** *DRKS00004375 on the 'German Clinical Trials Register'.*

## 1. INTRODUCTION

The nonmedical use of prescription medicines (NMUPM) is a debated topic in science, society and media (Arria and DuPont, 2010). For instance, interest in this topic was stirred in 2008 when one informal online poll revealed that 20% of a sample of 1,400 scientists from 60 countries reported that they had used medicines not prescribed by a physician to stimulate their focus, concentration, or memory (Maher, 2008). Currently, there are several prescription medicines available that are known for their potential to enhance cognitive functioning. One well-known substance is the stimulant ‘methylphenidate’ which is used for attention deficit hyperactivity disorder (ADHD) treatment. Methylphenidate formulations like Ritalin® and Concerta® are approved in Europe for the treatment of ADHD in children and adolescents, as well as for persons continuing treatment into adulthood. Regarding the approval of ADHD treatment for persons diagnosed in adulthood, there are differences across European countries. In Germany, methylphenidate is approved for treatment of adult ADHD (BfArM, 2011) and in the U.K., adult ADHD is recognized as a condition (NICE, 2016) whereas other countries, such as Belgium and Denmark, only approved methylphenidate for treatment of ADHD in children and adolescents aged 6–17 years. Methylphenidate was also the substance most commonly used by those scientists who reported cognitive enhancement in the above-mentioned study (Maher, 2008).

Previous research has demonstrated that the prevalence of NMUPM can be particularly high among university and college student populations compared to their same-age counterparts in the general population (Herman-Stahl et al., 2007). Most lifetime nonmedical users of prescription stimulants started consuming during high school (Austic, 2015) or during their early college years (Teter et al., 2006). Within the range of prescription medicines, stimulants were more often used by students compared to other medications, such as pain relief or anti-anxiety medications (Brandt et al., 2014). Reasons for nonmedical use of prescription stimulants (NMUPS) among university students

are to improve concentration and to perform better in university (Teter et al., 2006). Considering the existing evidence base of NMUPS, in our study, NMUPS was defined as the nonmedical use of medication which was not prescribed and which was used with the intention to improve academic performance.

The nonmedical use of prescription stimulants to improve cognitive achievement has raised some public health concerns because of possible adverse side effects in healthy young adults (Lakhan and Kirchgessner, 2012). Furthermore, an approved medication intended for a different indication may give consumers a false impression of such medication's safety combined with a low awareness of possible side effects if used non-prescribed (Compton and Volkow, 2006). Indeed, research has shown that NMUPS is associated with a higher likelihood to use other substances, including alcohol, tobacco and cocaine (Sepulveda et al., 2011). This is a major concern, because previous research suggested that students who used non-prescribed stimulants and alcohol simultaneously experienced considerably more negative consequences of use compared to students that did not use both substances at a time (Egan et al., 2013).

One highly influential factor in predicting substance use behavior in young people is the perception of the behavior among peers. Research in this field showed that inaccurate perceptions regarding others' substance use behavior exist (Perkins, 1997, 2007). Young adults may falsely assume that the peer group behaves differently from the actual existing norm (*misperception*) or from their individual self-reported behavior (*self-other discrepancies*; Borsari and Carey, 2003). Perceptions of substance use in the peer group can be related to the quantity and frequency of peer substance use (*descriptive norm*) or to perceptions of peer approval of substance use (*injunctive norm*). Most evidence on incorrect perceptions regarding substance use in student populations is related to descriptive norms regarding alcohol use (Berkowitz, 2004; Page et al., 2008; Perkins et al., 2005, 1999). It is known that perceived descriptive norms of peer alcohol use have an impact on individual drinking behavior. Studies showed that the perception of alcohol use among peers is related with higher likelihood of personally consuming alcohol more heavily (Lintonen and Konu,

2004; Perkins, 2007; Perkins and Wechsler, 1996). However, the role of descriptive norms in relation to NMUPS is not well understood. Furthermore, only a few studies have investigated the role of perceived injunctive norms in predicting personal substance use behavior. There is some indication that perceived peer approval of alcohol (McAlaney et al., 2015), tobacco (Pischke et al., 2015) and illicit substance use (Dempsey et al., 2016, Helmer et al., 2014) is associated with the personal approval toward such substances. Neighbors and colleagues also suggested that an association between injunctive drinking norms of proximal reference groups and personal drinking exists (Neighbors et al., 2008). However, we are unaware of any studies focussing on associations between perceived NMUPS approval and personal NMUPS in student populations.

The objectives of this study were to describe NMUPS among students from seven European countries, to assess discrepancies between estimated peer and personal NMUPS behavior/approval and to determine whether perceptions of peer norms are associated with personal NMUPS behavior/approval.

## **2. METHODS**

### *2.1. Data*

The 'Social Norms Intervention for the prevention of Polydrug use' (SNIPE)- project was a cross- national study which included students from universities in Belgium, Denmark, Germany, the Slovak Republic, Spain, Turkey and the United Kingdom. The project was funded by the European Commission (LS/2009-2010/DPIP/AG). The overall objective of SNIPE was to test the feasibility of a web-based personalised 'social norms'-feedback intervention for substance use for European students of the respective universities (for further detail, see Pischke et al., 2012). In brief, students were recruited from at least one designated intervention and one delayed intervention control university (McAlaney et al., 2015). In each country different means were used to recruit participants to register on the survey website, including emails, class announcements, and printed flyers. Subsequently, a hyperlink to the survey webpage was emailed to the registered participants. Study

participation was voluntary and participants were informed that their information was pseudonymised at study entry by replacing email-addresses with artificial identifiers in datasets. Students at the intervention universities received access to the 'social norms' feedback immediately after baseline assessment of licit and illicit substance use, those enrolled at the delayed intervention control universities received access to the online-feedback after the follow-up was completed at the intervention universities 5 months later. In the current manuscript, baseline results are reported for both students at intervention and delayed-intervention control universities. Statistical analysis was conducted based on an anonymous dataset. In each country, the participating universities obtained ethical approval from the respective responsible authorities.

The survey included questions on the student's personal use of licit (alcohol, tobacco), illicit substances (i.e., cocaine, ecstasy, amphetamines), as well as the personal NMUPS to improve academic performance. Students were also asked about their personal attitudes towards the use of these substances. Furthermore, perceptions of peer substance use behaviors and attitudes among students were assessed. Demographic data were also collected, including respondents' age, gender, migrant status, year of study and living situation (with other students or not).

## *2.2. Measurements*

To measure personal NMUPS, students were asked how often they used a medication which was not prescribed to improve academic performance followed by an example of a registered local trade name (Ritalin®) in six countries and the active component (Methylphenidate) in Turkey. Concerning their perceptions of NMUPS peer use, respondents were asked a question that was tailored to their gender and university: "How often in the last two months do you think most (at least 51%) of the [female/male] students at your university have used the following?". Response options for both questions ranged from 'Never in my/their life', 'Have used but not in the last two months' to 'Every day or nearly every day'.



Moreover, information about students' personal attitude towards NMUPS was collected employing the question "Which of the following best describes your attitude to using each of these substances?". Furthermore, students were asked about their perceptions of attitudes towards using NMUPS among their peers, using a sex-specific question "Which of the following do you think best describes the attitude of most (at least 51%) of the female/male students at your university to the use of each of these substances?". Response options for both questions were 'Never ok to use', 'Ok to use occasionally if it doesn't interfere with study or work', 'Ok to use frequently if it doesn't interfere with study or work', 'Ok to use occasionally even if it does interfere with study or work', 'Ok to use frequently if that is what the person wants to do'. Country, sex, age, year of study and living situation were considered potential determinants of NMUPS use/attitude towards NMUPS.

### *2.3. Statistical analysis*

Firstly, we estimated the personal substance use and attitudes towards NMUPS and 95% bootstrap confidence intervals based on 1,000 bootstrap samples for each participating country. From the study population, bootstrap samples were repeatedly drawn with replacement and personal substance use prevalence was calculated. Empirical distribution of the bootstrap estimate was used to derive 2.5- and 97.5-percentiles as confidence limits. Secondly, participants' self-other discrepancies were classified into three groups considering whether they personally perceived the NMUPS of the majority of same-sex peers as higher/ identical/ lower as the report of the corresponding personal behavior estimate. Thirdly, two binary logistic regression analyses were conducted to examine associations between perceived and personal behaviors (model 1) and perceived and personal attitudes (model 2). Sex, age, year of study, living situation and perceived substance use were included as independent variables in model 1. In model 2, all demographic variables, perceived attitude and personal NMUPS use were added as independent variables. In both models age was included as a continuous variable and all others as categorical variables. We added personal NMUPS use to the second model to assess whether the effect of perceived approval of NMUPS on personal approval of NMUPS is mediated by personal use. Furthermore, we examined

whether sex or country moderated the association between perception and personal behavior/attitude by adding interaction terms to both models. If interaction terms were significant at the  $p < 0.05$  level, we conducted stratified analyses. Data analysis was done with SPSS for windows, version 22.0.

### 3. RESULTS

The study included a total of 4,482 university students (71% female). Participant numbers across countries varied from 1,938 students in the Slovak Republic (43%) and 858 in Turkey (19%) to 504 in Germany (11%), 464 in Denmark (10%), 426 in Belgium (10%), 185 in Spain (4%) and 107 in the UK (2%). A detailed description of the sample is provided elsewhere (Helmer et al., 2014). Data on non-prescribed stimulant use/attitudes towards the use were available for 4,433/4,337 students.

Across all countries, 6% of the participants reported having used non-prescribed stimulants at least once in their life. Lifetime NMUPS was least common in Denmark (2%) and most common in the UK (11%). The majority of the overall sample stated that “it is never okay to use” non-prescribed stimulants (Table 1). In all countries, except for Turkey and Denmark, more than half of the students perceived that the majority of their same-sex peers had used non-prescribed stimulants at least once in their life. In the overall sample across countries, 50% thought that the majority of their peers used non-prescribed stimulants more frequently than themselves, 44% thought that the use was identical and only 6% thought that the use of the majority of their peers was lower than their personal use. 91% of students perceived that the peer approval towards NMUPS was identical or higher than their personal approval (Table 2).

Binary logistic regression model 1 revealed that the perception that the majority of same-sex peers had used non-prescribed stimulants at least once in their life was significantly associated with higher odds for personal use (OR: 3.30, 95% CI: 2.32-4.71). Examining injunctive norms, model 2 showed that students’ perceptions that the majority of same-sex peers approved NMUPS was

associated with a 4.03 (95% CI: 3.35-4.84) higher likelihood of personal approval of NMUPS use (Table 3).

In model 1, interaction terms showed that the effect of perception on NMUPS was not modified by country or by sex. Interaction analysis in model 2 revealed a significant modification by country on perceived attitude but no significant interaction by gender was observed. A stratified analysis of attitude towards NMUPS by country showed that the association between perceived peer attitudes and personal attitudes towards NMUPS use remained significant in all countries except for the UK.

#### **4. DISCUSSION**

The present study investigated the personal and perceived use of non-prescribed stimulants to improve academic performance and the personal and perceived attitudes towards using those medications in university students from seven European countries. Study participants generally perceived the NMUPS of the majority of their peers to be higher than their personal use. In addition, the majority of students perceived their peers to be equally or more approving of NMUPS than themselves. The descriptive norms were associated with an elevated personal NMUPS, the injunctive norms were associated with an elevated personal approval of NMUPS. To our knowledge, no other study has presented data on perceptions and use of non-prescribed stimulants in a large sample of university and college students enrolled at various universities across Europe.

Our study demonstrated that the use of non-prescribed stimulants differed between surveyed countries. This is in line with previous research (Schelle et al., 2015). In fact, the literature not only shows clear differences in the use of non-prescribed stimulants between countries but also within countries (McCabe et al., 2005). In a U.S.-study (McCabe et al., 2005), the 12-months prevalence of NMUPS ranged between 0 and 25% of students in participating colleges. More recent studies examining NMUPS among undergraduates demonstrated 12-month prevalences between 6% (McCabe, 2008) and 10% (Egan et al., 2013). A further study examining the lifetime prevalence of

NMUPS indicated that 34% of the respondents said they had used NMUPS (DeSantis et al., 2008). To date, only a limited number of studies have examined NMUPS in European students. These studies reported considerable differences in NMUPS prevalence. For instance, a study among 512 German university students reported a lifetime prevalence of 1% (Franke et al., 2011) and a more recent study including 3,798 Flemish university students showed a 5% lifetime NMUPS prevalence (Ponnet et al., 2015). Interestingly, in another study by Dietz et al. (2013) the 12-month prevalence of using cognitive-enhancing stimulants among 2,569 German university students was 20%, which was considerably higher than the lifetime estimate found in other studies.

Various reasons for these differences in reported prevalence are conceivable. First of all, the frequency of use may vary internationally or between college or university campuses (DeSantis et al., 2008). Also, NMUPS may be increasing by duration or stage of study, therefore variation can be expected between our study and other studies focused on undergraduate students (McCabe, 2008) or studies that made additional efforts to survey students in the years post-graduation (DeSantis et al., 2008). Furthermore, in our study, students were only asked to report the perception of peer use/personal use of medication that was not prescribed to improve academic performance. In the majority of the other studies reporting on NMUPS, broader definitions of NMUPS were used which may account for differences in the reported NMUPS. Also, some of these studies included other stimulants that are available without a prescription, such as caffeine (Dietz et al., 2013). Furthermore, timeframes of assessment in other epidemiological studies typically refer to use in the last year. In our study, we chose a 2-months timeframe because it covered the period during which students were attending university excluding semester breaks. Moreover, similar to McCabe et al. (2008; 2005), we used web-based surveys whereas other studies used paper and pencil questionnaires to survey NMUPS (DeSantis et al., 2008; Dietz et al., 2013) which may result in a different response rate.

The majority of surveyed participants in this study displayed self-other discrepancies in NMUPS meaning that they were under the assumption that the majority of their peers had used non-

prescribed medication more often than themselves. To date, no other study has evaluated self-other discrepancies. However, one U.S.-study compared perceptions of NMUPS and the actual median value of self-reported use demonstrating overestimations (Sanders et al., 2014). Another study by McCabe et al. (2008) showed misperceptions by contrasting perception of NMUPS and the actual use at the university. In the mentioned study students thought that on average 20% of their peers on campus had used NMUPS at least once in the past year in contrast to an actual rate of 6.0% of peers reporting NMUPS in the last 12 months. In this sample, 70.2% of students overestimated the prevalence of NMUPS of their peers (McCabe, 2008). More recently Kilmer et al. (2015) found that 89% of the students perceived that a typical student at their university had used stimulants either with or without a prescription at least once, yet the data on NMUPS suggested that the majority of students had been abstinent. DeSantis et al. (2013) took a closer look at the perceived NMUPS among distributors of those substances, i.e., fellow students with a medical prescription for ADHD stimulants distributing those to students without prescriptions and showed that overestimations also existed in this subgroup.

Our study is the first examining the discrepancy between the personal and perceived peer approval of NMUPS. We found that 39% of the participating students thought that their peers were more approving of NMUPS than themselves. To our knowledge, there is only one study by Maher (2008) based upon an informal online poll that examined NMUPS approval among scientists. This study showed that the approval of NMUPS was relatively high with four-fifths of the respondents reporting that healthy adults should be able to use medication not prescribed for them if they want to (Maher, 2008). However, in terms of alcohol use among students, there is extensive meta-analytic evidence that a gap exists between students' personal attitudes towards alcohol use and the perceived approval of other students (Borsari and Carey, 2003). Students viewed their peers to be more approving of alcohol use than they actually were (Borsari and Carey, 2003). Research examining this gap for a range of illicit substances (e.g., cocaine, amphetamines) revealed comparable results (Helmer et al., 2014).

University students across all participating countries who thought that the majority of peers used non-prescribed medication were more likely to report personal NMUPS. This association is consistent with findings of Kilmer et al. (2015) among U.S.-students. Findings of other studies (e.g., McCabe, 2008; Sanders et al., 2014) suggest that users of non-prescribed medication were more likely to overestimate use of the corresponding substance in their peer group. Our study also revealed an association between perceived peer approval and personal approval of NMUPS. Similar findings have been reported in the SNIPE study with respect to other licit (McAlaney et al., 2015; Pischke et al., 2015) and illicit substances (Helmer et al., 2014).

However, this study had certain limitations. The use of self-report data may have resulted in underestimates or overestimates of NMUPS prevalence, depending on respondents' own recollection and willingness to report illicit stimulant use. It is noteworthy that data were collected via a confidential online survey, which has been shown to produce high quality data in substance use research in university students (Kypri et al., 2004). The measure for NMUPS employed in this study may have also led to underreporting because only a choice of local trade names (e.g., Ritalin®) or the active component was included as an example. Furthermore, differences in medical availability of methylphenidate and other prescribed stimulants in Europe may have contributed to differences in NMUPS by country; however, because the main focus of our study was not on potential between-country differences, differences are not reported in this article. Another factor that may have caused a certain degree of misreporting of NMUPS could have been that we asked participants for their individual e-mail addresses in order to be able to subsequently send them the link to the intervention after the completion of the baseline survey. This may have caused concerns regarding anonymity among study participants; however, participants were informed that their e-mail addresses were not included in the analysis datasets, and would be deleted as soon as possible. In addition, our sample is not representative for student populations in the different countries as we conducted the survey at single universities in the respective countries, using broad, but voluntary recruitment without being able to systematically address all students. At the majority of universities, e-mail was used to invite

students to participate in the study. Specifically, distribution lists provided by university administrations were used to reach students. However, because no data are available regarding the use of university email by students at the respective universities, we can only provide rough estimates of the number of students reached at each university. We therefore chose not to include this information in the current article. Therefore, we cannot rule out that selection bias may have led to higher or lower rates of self-reported use of non-prescribed stimulants in students. Lastly, the cross-sectional analysis of baseline data does not allow for causal inferences regarding the association between perceptions and personal use.

There are several potential consequences associated with the non-prescribed prescription stimulant use, such as not receiving a medical instruction, unknown health consequences and involvement in other substance use (McCabe et al., 2006). Hence, suitable prevention strategies are required. Our data suggest that interventions focused on the prevention of NMUPS should take the important role of descriptive and injunctive norms among European college populations into account. However, to further tailor interventions to this target group, more information is needed on why certain students show self-other discrepancies while others do not. Also, findings by Austic (2015) indicate that the peak of incidence rates for nonmedical use of prescription stimulants occurred between the ages of 16 and 19 years, suggesting that interventions should target misperceptions at an earlier age and should possibly be implemented in the school setting. Furthermore, the motives behind the use should be taken into account when designing future prevention strategies. Studies in this area of research suggest that the main motives for NMUPS are expectations of improved concentration and vigilance. Furthermore, high stress levels and academic workload were found to be associated with these motives (Eickenhorst et al., 2012), suggesting that students tend to use stimulants when they are overwhelmed with academic demands.

To conclude, the findings of this cross-national study extend the body of international literature regarding students' use of non-prescribed medication to improve academic performance.

Further quantitative and qualitative research is needed to better understand NMUPS and factors involved in NMUPS from the perspective of students.

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Contributors:

SH planned and carried out the analyses, and wrote the manuscript. BV, GvH, RD, YA, FGG, FS, CS contributed to the design of the study, guided the data collection and revised the paper. CP and HZ participated in designing and coordinating the study as well as in performing the statistical analyses and writing and revising the paper. All authors read and approved the final manuscript.

Conflict of interest:

The authors declare that they have no competing interests.

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**REFERENCES**

Arria, A.M., DuPont, R.L., 2010. Nonmedical prescription stimulant use among college students: why we need to do something and what we need to do. *J. Addict. Dis.* 29, 417-426.

Austic, E.A., 2015. Peak ages of risk for starting nonmedical use of prescription stimulants. *Drug Alcohol Depend.* 152, 224-229.

Berkowitz, A.D., 2004. *The Social Norms Approach: Theory, Research, and Annotated Bibliography*. Berkowitz, Trumansburg, NY.

Bundesinstitut für Arzneimittel und Medizinprodukte (BfArM), 2011. Methylphenidat auch für Erwachsene: BfArM erweitert Zulassung URL: <http://www.bfarm.de/SharedDocs/Pressemitteilungen/DE/mitteil2011/pm02-2011.html> (accessed: May 22, 2016)

Borsari, B., Carey, K.B., 2003. Descriptive and injunctive norms in college drinking: a meta-analytic integration. *J. Stud. Alcohol Drugs* 64, 331-341.

Brandt, S.A., Taverna, E.C., Hallock, R.M., 2014. A survey of nonmedical use of tranquilizers, stimulants, and pain relievers among college students: patterns of use among users and factors related to abstinence in non-users. *Drug Alcohol Depend.* 143, 272-276.

Compton, W.M., Volkow, N.D., 2006. Abuse of prescription drugs and the risk of addiction. *Drug Alcohol Depend.* 83 Suppl. 1, 4-7.

Dempsey, R.C., McAlaney, J., Helmer, S.M., Pischke, C.R., Akvardar, Y., Bewick, B.M., Fawkner, H.J., Guillen-Grima, F., Stock, C., Vriesacker, B., Van Hal, G., Salonna, F., Kalina, O., Orosova, O., Mikolajczyk, R.T., 2015. Normative perceptions of cannabis use amongst European University students: associations between perceived peer use and peer attitudes with personal use and attitudes. *J. Stud. Alcohol Drugs*, in press.

- DeSantis, A.D., Anthony, K.E., Cohen, E.L., 2013. Illegal college ADHD stimulant distributors: characteristics and potential areas of intervention. *Subst. Use Misuse* 48, 446-456.
- DeSantis, A.D., Webb, E.M., Noar, S.M., 2008. Illicit use of prescription ADHD medications on a college campus: a multimethodological approach. *J. Am. Coll. Health* 57, 315-324.
- Dietz, P., Striegel, H., Franke, A.G., Lieb, K., Simon, P., Ulrich, R., 2013. Randomized response estimates for the 12-month prevalence of cognitive-enhancing drug use in university students. *Pharmacotherapy* 33, 44-50.
- Egan, K.L., Reboussin, B.A., Blocker, J.N., Wolfson, M., Sutfin, E.L., 2013. Simultaneous use of non-medical ADHD prescription stimulants and alcohol among undergraduate students. *Drug Alcohol Depend.* 131, 71-77.
- Eickenhorst, P., Vitzthum, K., Klapp, B.F., Groneberg, D., Mache, S., 2012. Neuroenhancement among German university students: motives, expectations, and relationship with psychoactive lifestyle drugs. *J. Psychoactive Drugs* 44, 418-427.
- 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, 60-66.
- Helmer, S.M., Mikolajczyk, R.T., McAlaney, J., Vriesacker, B., Van Hal, G., Akvardar, Y., Guillen-Grima, F., Salonna, F., Stock, C., Dempsey, R.C., Bewick, B.M., Zeeb, H., 2014. Illicit substance use among university students from seven European countries: a comparison of personal and perceived peer use and attitudes towards illicit substance use. *Prev. Med.* 67, 204-209.
- Herman-Stahl, M. A., Krebs, C. P., Kroutil, L. A., Heller, D. C., 2007. Risk and protective factors for methamphetamine use and nonmedical use of prescription stimulants among young adults aged 18 to 25. *Addict. Behav.* 32, 1003-1015.

Kilmer, J.R., Geisner, I.M., Gasser, M.L., Lindgren, K.P., 2015. Normative perceptions of non-medical stimulant use: associations with actual use and hazardous drinking. *Addict. Behav.* 42, 51-56.

Kypri, K., Gallagher, S.J., Cashell-Smith, M.L., 2004. An internet-based survey method for college student drinking research. *Drug Alcohol Depend.* 76, 45-53.

Lakhan, S.E., Kirchgessner, A., 2012. Prescription stimulants in individuals with and without attention deficit hyperactivity disorder: misuse, cognitive impact, and adverse effects. *Brain Behav.* 2, 661-677.

Lintonen, T.P., Konu, A.I., 2004. The misperceived social norm of drunkenness among early adolescents in Finland. *Health Educ. Res.* 19, 64-70.

Maher, B., 2008. Poll results: look who's doping. *Nature* 452, 674-675.

McAlaney, J., Helmer, S.M., Stock, C., Vriesacker, B., Van Hal, G., Dempsey, R.C., Akvardar, Y., Salonna, F., Kalina, O., Guillen-Grima, F., Bewick, B.M., Mikolajczyk, R.T., 2015. Personal and perceived peer use of and attitudes toward alcohol among university and college students in seven EU countries: Project SNIPE. *J. Stud. Alcohol Drugs* 76, 430-438.

McCabe, S.E., 2008. Misperceptions of non-medical prescription drug use: a web survey of college students. *Addict. Behav.* 33, 713-724.

McCabe, S.E., Knight, J.R., Teter, C.J., Wechsler, H., 2005. Non-medical use of prescription stimulants among US college students: prevalence and correlates from a national survey. *Addiction* 100, 96-106.

McCabe, S.E., Teter, C.J., Boyd, C.J., 2006. Medical use, illicit use and diversion of prescription stimulant medication. *J. Psychoactive Drugs* 38, 43-56.

Neighbors, C., O'Connor, R.M., Lewis, M.A., Chawla, N., Lee, C.M., Fossos, N., 2008. The relative impact of injunctive norms on college student drinking: the role of reference group. *Psychol. Addict. Behav.* 22, 576-581.

NICE, 2016. Attention deficit hyperactivity disorder: the NICE Guideline on diagnosis and management of ADHD in children, young people and adults. URL: <https://www.nice.org.uk/guidance/cg72/evidence/adhd-full-guideline-241963165> (accesses: May 22, 2016)

Page, R.M., Ihasz, F., Hantiu, I., Simonek, J., Klarova, R., 2008. Social normative perceptions of alcohol use and episodic heavy drinking among Central and Eastern European adolescents. *Subst. Use Misuse* 43, 361-373.

Perkins, H.W., 1997. College student misperceptions of alcohol and other drug norms among peers: exploring causes, consequences, and implications for prevention programs. In: The Higher Education Center for Alcohol, Other Drug Prevention, U.S. Department of Education (Eds.), *Designing Alcohol and Other Drug Prevention Programs in Higher Education: Bringing Theory into Practice*. Newton, MA, pp. 177-206.

Perkins, H.W., 2007. Misperceptions of peer drinking norms in Canada: another look at the "reign of error" and its consequences among college students. *Addict. Behav.* 32, 2645-2656.

Perkins, H.W., Haines, M.P., Rice, R., 2005. Misperceiving the college drinking norm and related problems: a nationwide study of exposure to prevention information, perceived norms and student alcohol misuse. *J. Stud. Alcohol Drugs* 66, 470-478.

Perkins, H.W., Meilman, P.W., Leichliter, J.S., Cashin, J.R., Presley, C.A., 1999. Misperceptions of the norms for the frequency of alcohol and other drug use on college campuses. *J. Am. Coll. Health* 47, 253-258.

Perkins, H.W., Wechsler, H., 1996. Variation in perceived college drinking norms and its impact on alcohol abuse: a nationwide study. *J. Drug Issues* 26, 961-974.

Pischke, C.R., Helmer, S.M., McAlaney, J., Bewick, B.M., Vriesacker, B., Van Hal, G., Mikolajczyk, R.T., Akvardar, Y., Guillen-Grima, F., Salonna, F., Orosova, O., Dohrmann, S., Dempsey, R.C., Zeeb, H., 2015. Normative misperceptions of tobacco use among university students in seven European countries: baseline findings of the 'Social Norms Intervention for the prevention of Polydrug use' study. *Addict. Behav.* 51, 158-164.

Pischke, C.R., Zeeb, H., van Hal, G., Vriesacker, B., McAlaney, J., Bewick, B.M., Akvardar, Y., Guillen-Grima, F., Orosova, O., Salonna, F., Kalina, O., Stock, C., Helmer, S.M., Mikolajczyk, R.T., 2012. A feasibility trial to examine the social norms approach for the prevention and reduction of licit and illicit drug use in European University and college students. *BMC Public Health* 12, 882.

Ponnet, K., Wouters, E., Walrave, M., Heirman, W., Van Hal, G., 2015. Predicting students' intention to use stimulants for academic performance enhancement. *Subst. Use Misuse* 50, 275-282.

Sanders, A., Stogner, J., Seibert, J., Miller, B.L., 2014. Misperceptions of peer pill-popping: the prevalence, correlates, and effects of inaccurate assumptions about peer pharmaceutical misuse. *Subst. Use Misuse* 49, 813-823.

Schelle, K.J., Olthof, B.M.J., Reintjes, W., Bundt, C., Gusman-Vermeer, J., van Mil, A.C.C.M., 2015. A survey of substance use for cognitive enhancement by university students in the Netherlands. *Front. Syst. Neurosci.* 9, 10.

Sepulveda, D.R., Thomas, L.M., McCabe, S.E., Cranford, J.A., Boyd, C.J., Teter, C.J., 2011. Misuse of prescribed stimulant medication for ADHD and associated patterns of substance use: preliminary analysis among college students. *J. Pharm. Pract.* 24, 551-560.

Teter, C.J., McCabe, S.E., LaGrange, K., Cranford, J.A., Boyd, C.J., 2006. Illicit use of specific prescription stimulants among college students: prevalence, motives, and routes of administration. *Pharmacotherapy* 26, 1501-1510.

Table 1: Personal NMUPS and approval of NMUPS by country and sex (95% bootstrap CI)

		Belgium		Denmark		Germany		Slovak Republic		Spain		Turkey		UK	
		Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
NMUPS (%) (n=4433)	Used in the last two months	2.4 (0.0-6.1)	2.5 (0.9-4.4)	0.0 (0.0-0.0)	0.0 (0.0-0.0)	2.5 (0.5-4.8)	0.3 (0.0-1.1)	1.6 (0.5-2.9)	3.5 (2.6-4.6)	0.0 (0.0-0.0)	0.8 (0.0-2.5)	1.1 (0.3-2.2)	0.7 (0.0-1.6)	3.1 (0.0-11.1)	1.4 (0.0-4.6)
	Used once in their life	7.1 (2.2-13.3)	4.4 (2.3-6.8)	4.1 (0.9-8.3)	1.7 (0.6-3.3)	6.9 (3.6-10.8)	1.7 (0.3-3.4)	8.4 (5.7-11.4)	8.3 (6.9-9.7)	4.0 (0.0-10.4)	5.6 (1.7-10.2)	2.7 (1.1-4.5)	4.8 (2.7-6.9)	12.5 (2.9-24.3)	10.0 (4.0-17.6)
Approval of NMUPS (%) (n=4337)	Never ok to use	72.9 (63.2-82.3)	72.0 (67.0-76.8)	80.4 (72.3-88.3)	89.5 (86.2-92.7)	70.4 (63.8-76.9)	78.8 (74.1-83.7)	74.4 (69.9-78.8)	67.9 (65.5-70.4)	74.0 (61.4-85.7)	64.0 (55.1-72.1)	88.2 (84.6-91.4)	88.3 (85.2-91.2)	53.1 (34.9-71.0)	75.7 (65.2-85.1)
	Ok to use if it doesn't interfere with work or study*	21.2 (12.1-30.0)	25.8 (20.9-30.8)	11.3 (5.1-18.5)	7.3 (4.5-10.1)	22.7 (17.1-28.8)	16.4 (12.0-20.7)	22.5 (18.4-26.5)	30.0 (27.6-32.3)	22.0 (10.8-33.3)	30.4 (22.4-38.7)	9.6 (6.7-12.8)	10.0 (7.2-12.8)	40.6 (22.6-59.0)	18.6 (10.3-28.4)
	Ok to use**	5.9 (1.2-11.4)	2.2 (0.6-4.0)	8.2 (3.2-14.3)	3.2 (1.4-5.2)	6.9 (3.5-10.7)	4.8 (2.4-7.3)	3.1 (1.5-4.9)	2.1 (1.4-2.9)	4.0 (0.0-10.0)	5.6 (2.2-9.7)	2.1 (0.8-3.7)	1.7 (0.5-3.0)	6.3 (0.0-15.2)	5.7 (0.0-11.8)

\* 'Ok to use occasionally if it doesn't interfere with study or work', 'Ok to use frequently if it doesn't interfere with study or work' were collapsed into Ok to use if it doesn't interfere with work or study

\*\*'Ok to use occasionally even if it does interfere with study or work', 'Ok to use frequently if that is what the person wants to do' were collapsed into Ok to use

*Table 2: Differences between personal NMUPS /approval of NMUPS and the perceived NMUPS /approval of NMUPS of the majority of peers of the same sex and same university (self-other discrepancies)*

	<i>Lifetime NMUPS (%) (n=4433)</i>	<i>Approval of NMUPS (%) (n=4337)</i>
<i>Majority of their same- sex peers &lt; own</i>	3.8	8.8
<i>Majority of their same- sex peers = own</i>	37.3	52.5
<i>Majority of their same- sex peers &gt; own</i>	58.9	38.7

Table 3: Associations between personal NMUPS /personal attitude towards NMUPS and perceived lifetime NMUPS of peers/ attitude of peers, personal NMUPS, country, age, sex as well as living situation– Results of binary log. Regressions

Variables	Ever used NMUPS	Positive attitude towards NMUPS (okay to use and okay to use if it does not interfere with study or work)
	OR (95% CI)	OR (95% CI)
<b>Perceived peer behavior (Lifetime NMUPS)</b>	3.30 (2.32-4.71)	
Perceived peer behavior (Not used NMUPS)	1.00	
<b>Perceived peer attitude towards NMUPS (Never okay to use)</b>	--	1.00
Perceived peer attitude towards NMUPS use (okay to use)	--	4.03 (3.35-4.84)
<b>Never used NMUPS</b>		1.00
Ever used NMUPS		13.65 (9.73-19.15)
<b>Country</b>		
<i>Slovak Republic</i>	1.00	1.00
<i>Belgium</i>	0.52 (0.33-0.85)	0.80 (0.61-1.04)
<i>Denmark</i>	0.29 (0.14-0.60)	0.62 (0.43-0.89)
<i>Germany</i>	0.42 (0.25-0.72)	1.07 (0.82-1.40)
<i>Spain</i>	0.55 (0.27-1.11)	1.14 (0.84-2.90)
<i>Turkey</i>	0.58 (0.39-0.88)	1.27 (0.86-1.80)



<i>United Kingdom</i>	1.35 (0.69-2.66)	0.44 (0.32-0.58)
<b>Age</b>	0.99 (0.96-1.04)	0.96 (0.93-0.98)
<b>Sex</b>		
<i>Female</i>	1.00	1.00
<i>Male</i>	1.24 (0.93-1.65)	1.04 (0.87-1.26)
<b>Living situation</b>		
<i>With other students</i>	1.00	1.00
<i>Alone or with partner</i>	0.94 (0.62-1.40)	0.92 (0.71-1.18)
<i>With parents</i>	0.79 (0.59-1.06)	0.97 (0.81-1.17)
<i>Other</i>	0.72 (0.32-1.62)	0.77 (0.47-1.26)

†All variables in the table were included in the logistic regression analysis and are therefore controlled for. Year of study was included as a categorical variable in the model but was not found to be a significant predictor and is not shown in the table.