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PHARMACEUTICAL COGNITIVE ENHANCEMENT AMONG SLOVENIAN UNIVERSITY STUDENTS

Abstract. *Over the past two decades, the concept of human enhancement – the idea that the normal capabilities of healthy people can be enhanced through direct technological interventions into the body – has garnered increasing attention in some scientific circles. Most potential enhancement technologies are still in research and development, with a few exceptions, such as pharmaceutical drugs that can increase concentration, memory and wakefulness. Such use has been conceptualized as "pharmaceutical cognitive enhancement" (PCE), and PCE use among students is cited as signifying an important new trend that requires expert and public attention. The article takes up the call to explore PCE trends in national contexts. The results of an online survey covering experiences and attitudes towards PCE among 445 undergraduate students at the University of Ljubljana, Slovenia, have shown that 6,1 % have already used PCE. Regarding attitudes, 26 % of users and 20 % of nonusers though that healthy adults should be permitted to use PCE according to their own judgment, while 33 % of users and 21 % of nonusers stated they will probably use PCE in the future. A tangible percentage of PCE use is present, but it requires interpretation and several different contextual interpretations are proposed. Ultimately, societies will need to decide how to interpret and potentially address the trend at the national and possibly international level.*
Keywords: *neuroenhancement, pharmaceuticals, students, drug use, pharmaceutical cognitive enhancement, methylphenidate, modafinil*

Introduction: Human Enhancement

The striving to improve and exceed existing human capabilities has been present in human cultures throughout the history of civilization. Early attempts to enhance physical and mental capacities made use of primitive

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tools, language, writing, plant and animal domestication, as well as the physical and mental effects of specific plant- and animal-derived substances (Ratsch, 2005; Yesalis, 2002). With the development of more complex societies, and later industrialization, technology began to exert an increasingly important and transformative impact on the individual and on society. Until the 20th century, technological augmentations of human capabilities remained predominantly external to the human body, but more recent changes and advances in science and technology, as well as in sociocultural valuations, have led to new modes of enhancing human capacities. Thus numerous novel technologies, emerging from the synergistic combinations and mutual stimulation of developments in the four expansive domains of nanotechnology, biotechnology, information technology and cognitive science (Roco and Bainbridge, 2003), coupled with increasing sociocultural emphasis on individualization, autonomy, personal responsibility, wellbeing, performance, competitiveness and entrepreneurship, are driving the development of applications that promise to greatly increase and extend human capacities, not only through external augmentation, but through direct technological interventions into the human body, especially the brain (Buchanan, 2011; Harris, 2007). Such transformations are giving rise to a "Culture of Life" (Knorr Cetina, 2005) or to "Humanity 2.0" (Fuller, 2013), where the possibility of individual perfectibility is seen as increasingly realizable through the use of scientific and technological enhancement.

Over the past two decades, the concept of human enhancement (HE), the idea that the increase and expansion of human capabilities beyond the "normal" or "average" range through the employment of technological interventions is both possible and potentially desirable, has become a prominent topic in some scientific circles (Savulescu and Bostrom, 2009; Savulescu et al., 2011), and more recently, also in policy advisory documents at the national (DCE, 2010; HCN, 2003; POST, 2007; Sauter and Gerlinger, 2012) and the transnational level (Allhoff et al., 2011; Coenen et al., 2009).

HE has been defined as "an intervention that improves the functioning of some subsystem of an organism beyond its reference state; or that creates an entirely new functioning or subsystem that the organism previously lacked" (Bostrom, 2008: 179). On the one hand, proponents of HE argue that the development and use of human enhancement technologies (HET) will enable lives that are longer, smarter and happier (Hughes, 2004), greatly expanded cognitive capabilities that will result in individual and societal benefits (Bostrom and Sandberg, 2009), and open up new modalities for addressing physical (Miah, 2011) and emotional challenges (Walker, 2013). On the other hand, the opponents claim that HET use will undermine cherished and important human and societal values (Sandel, 2007), damage or diminish the spectrum of human nature (Fukuyama, 2002), or have

disruptive and destructive impacts on the societal fabric (McKibben, 2004).

There are numerous new and emerging technologies that could also serve as potential HET, as many technological applications have the possibility of "parallel applicability" (de Grey and Rae, 2007: 85), meaning that they can have therapeutic effects of curing or alleviating conditions in persons with diseases, disabilities or disorders, and enhancing effects on specific functionalities or bodily subsystems, which are already defined as average, normal or healthy according to predominant medical and sociocultural criteria. Such potential HET applications are emerging from advances in new fields such as nanotechnology, neurotechnology, synthetic biology, genetic engineering, regenerative medicine, new reproductive technologies, brain-computer interfaces, cybernetic implants, robotics and artificial intelligence (see Beckert et al., 2009; Beckert, 2011). Most of them are still in the research and development or early testing phases, although their potential (future) implications have already been subject to numerous economic, ethical, legal and societal impact assessments, both in the scientific literature and by advisory bodies in the policymaking process (for an overview of the latter, see Mali et al., 2012).

Some families of pharmacological drugs represent one of the few existing HET that are already in use, and are being tentatively employed in several application fields of HE, e.g. to increase muscle mass, accuracy and aerobic endurance in the scope of enhancing physical abilities, to increase healthy lifespan, improve mood and enhance cognitive capacities, such as attention and wakefulness. The use of prescription drugs for the purposes of enhancing cognitive function among the healthy has recently received much attention in the scientific literature, especially because of its potential impacts on productivity, efficiency, cognitive work and special occupations, in addition to personal and societal savings due to increased wakefulness, memory and attention (Bostrom and Sandberg, 2009; Sandberg and Savulescu, 2011), as well as due to concerns regarding negative impacts on health, individual wellbeing and existing societal structures and mechanisms (Kass, 2003; Elliot, 2003). And such use of pharmaceuticals for cognitive enhancement also brings up many other salient issues, especially questions of existing use and potential user populations, some of which will be explored in the continuation.

The Concept of Pharmaceutical Cognitive Enhancement

Pharmaceutical cognitive enhancement (PCE), as a subset of the broader concept of HE, has been tentatively defined as the enhancement of normal neurocognitive function by pharmacological means with the aim to improve the psychological function of individuals who are not ill (Farah et

al., 2004: 421). In order to differentiate it from recreational use of prescription or illicit drugs, usually connected with seeking pleasurable or non-ordinary states of mind, PCE can generally be considered in terms of improving cognitive capabilities such as attention, concentration, wakefulness and memory through the use of pharmacological stimulants.[1] The latter are usually comprised of methylphenidate (MPH) in products like Ritalin and Concerta, amphetamines (AMP) in products like Adderall and Dexedrine, and modafinil (MDF) in products like Vigil and Provigil.[2] The aims of such use are thus mainly to increase performance work or general life performance, especially regarding cognitively intensive and demanding tasks.

Most proponents of PCE (Bostrom and Sandberg, 2009; Farah et al., 2004; Galert et al., 2009; Greely et al., 2008; Mehlman, 2004; Sahakian and Morein-Zamir, 2007) have put forward proposals for policy actions that would enable the development of safer and more effective pharmaceutical cognitive enhancers, and support the trend of PCE among various populations through institutional structures, expert counseling and further research of the biological and societal aspects of the trend. Adding urgency to such proposals, these authors note, are observations derived from surveys on both illicit and pharmaceutical drug use, especially among students, but also among cognitive workers, such as scientists, researchers and professors, doctors and soldiers, suggesting that the trend of PCE use is already widespread and steadily increasing. As the use of PCE among students is generally taken as being backed by empirical data and a reliable indicator regarding PCE use, the continuation of this article focuses on PCE use among this segment of the population.

Regarding specific numbers of PCE use among students, various surveys usually do not differentiate between recreational and PCE use, and the results can vary greatly depending on the specific sample demographic and the educational institution(s) included in the survey. In a meta-analysis of surveys that encompassed varying samples at different colleges in the US and Canada, Smith and Farah (2011: 719–23) observe that the numbers of nonmedical stimulant use among college students, in surveys with smaller samples, are 16,6 % (lifetime use, 2000 survey), 35,3 % (past year use, 2002 survey), 13,7 % (lifetime use, 2005 survey), 9,2 % (lifetime use, 2006 survey), and 55 % (lifetime use, 2009 survey). The results of surveys with larger samples (more than a thousand students) are 2,5 % (past year use, 2003 survey), 5,4 % (past year use, 2005 survey), 4,1 % (past year use, 2005 survey), 11,2 %

[1] *Although there is disagreement as to whether pharmacological substances should be treated as different from other means, such as dietary supplements, mind-training techniques or computational devices (see for example Bostrom & Sandberg, 2009).*

[2] *Most of the pharmacological stimulants are indicated for the treatment of ADHD (Attention Deficit and Hyperactivity Disorder) and various disorders of cognitive functions.*

(past year use, 2006 survey), 5,9% (past year use; 2006 survey), 16,2% (lifetime use, 2006 survey), 1,7% (past month use, 2007 survey), 10,8% (past year use, 2008 survey); 5,3% (lifetime use, 2008 survey); 34% (lifetime use, 2008 survey), 8,9% (lifetime use, 2009 survey), and 7,5% (past month use, 2009 survey).

Although some authors (Partridge et al., 2011) have been critical of the extrapolations (or, as they claim, exaggerations and misinterpretations) made of such surveys in regard to the extent and growth of PCE described both in the media and in the scientific literature, it is important, as Singh and Rose (2006: 101) point out, to ground the discussions of the implications of PCE on empirical research, which examines the contemporary everyday uses of pharmaceutical drugs for cognitive enhancement purposes, investigating, for example, how, where, by whom and to what purpose such drugs are being used. A majority of such empirical investigations have been focused on North American students and colleges, and there have been, up to now, few surveys conducted specifically on PCE in European countries (with notable exceptions, such as an extensive German (Franke et al., 2011; Franke et al., 2012) and a small Italian (Castaldi, 2012) survey on PCE).

Following the recommendations that such (possibly global) trends also need to be explored and situated in a specific (national) context, in order to base potential policy actions regarding PCE on firm and extensive empirical foundations, and given that such research is scant in European countries, the present article focuses on the examination of PCE use, as well as of opinions and attitudes towards PCE among undergraduate students at the University of Ljubljana, Slovenia.

Methodology: Undergraduate Students at the University of Ljubljana

The survey on neuroenhancement consisted of a structured questionnaire with approximately 40 questions, intended to explore the experiences with pharmacological drugs used for cognitive enhancement, as well as of opinions and attitudes towards PCE among undergraduate students of the University of Ljubljana[3] in a national (Slovenian) context. The questions were composed with regard to the relevant literature on PCE as well as some existing surveys on the topic (Maher, 2008).

The survey was conducted between November 2012 and March 2013 in the form of an anonymous online survey questionnaire, which was placed into the Free Online Surveys system. Invitations were sent out to individual

[3] *The University of Ljubljana is a very large University, even by international standards, with approximately 50.000 students.*

Faculties and Academies that are members of the University of Ljubljana, via e-mail, asking them to invite their students to participate in the survey. Out of the 26 Faculties and Academies invited to participate, replies eventually came from 445 students from 15 faculties. The details regarding individual response rates are given in Table 1 below.

Table 1: STUDENT RESPONSE RATES AT INDIVIDUAL FACULTIES

Member institution of the University of Ljubljana	Number of respondents	Percentage of total
Academy of Music	1	0,2%
Academy of Theater, Radio, Film and Television	17	3,8%
Biotechnical Faculty	4	0,9%
Faculty of Economics	1	0,2%
Faculty of Social Sciences	2	0,4%
Faculty of Electrical Engineering	26	5,8%
Faulty of Civil and Geodetic Engineering	46	10,4%
Faculty of Chemistry and Chemical Technology	73	16,4%
Faculty of Mathematics and Physics	2	0,4%
Faculty of Computer and Information Science	1	0,2%
Faculty of Social Work	66	14,8%
Faculty of Sport	19	4,4%
Faculty of Arts	5	1,1%
Faculty of Medicine	174	39,2%
Faculty of Natural Sciences and Engineering	7	1,6%
Faculty of Education	1	0,2%
Total	**445**	**100%**

According to their answer to the primary question, on whether they had ever used PCE drugs (such as MPH, AMP and MDF) with the aim of enhancing concentration, memory, wakefulness, calmness, etc., the respondents were divided into two groups. The first is composed of "nonusers" (those who answered with no, and those who answered that they had used pharmaceutical stimulants for medical reasons, that is, a doctor had prescribed them for a diagnosed illness or disorder). The second is composed of "users" (those who answered that they had used them for nonmedical reasons of enhancing attention, memory, wakefulness, calmness, etc., and those who responded that they had used them both for medical and for nonmedical reasons).

A reservation regarding the results should also be mentioned. As the survey was conducted in the form of an online survey, it is possible that those more interested or knowledgeable in the topic of PCE were more likely to respond. Further, more than a third of respondents were from the Faculty of medicine, and this might reflect the fact that students from some faculties (e.g., medicine, chemistry, pharmacy) have more knowledge regarding PCE

drugs as well as easier access to the them, potentially making them more likely to experiment with PCE.

Results: Experiences and Attitudes of Students Towards PCE

The survey on PCE was completed by 445 undergraduate students, among whom 308 were female (69,2%) and 137 were male (30,8%).

Table 2: PERCEPTION OF SELECTED ISSUES AND ATTITUDES TOWARDS PCE

EXPERIENCES AND OPINIONS REGARDING PCE DRUGS		
Issue	**Users**	**Non-Users**
Have used PCE drugs	27 (6,1%)	/
Consider PCE drugs ineffective	/	4% (17)
Consider PCE drugs slightly effective	7% (2)	20% (85)
Consider PCE drugs moderately effective	22% (6)	10% (84)
Consider PCE drugs very effective	15% (4)	2% (9)
Negative effects trump positive ones	7% (2)	24% (99)
Familiar with PCE concept/use	41 (11%)	42% (177)
Will probably use PCE in future	33% (9)	21% (87)
Would feel pressure to use if PCE was used by colleagues	11% (3)	18% (76)
ATTITUDES TOWARDS PCE REGULATION		
Issue	**Users**	**Non-Users**
Healthy adults should be permitted to use PCE	26% (7)	20% (82)
Establish institutions for counseling/prescribing PCE	11% (3)	54% (226)
No regulatory changes needed	22% (6)	14% (57)
PCE use should be permitted/legal	15% (4)	6% (25)
PCE use should be banned	/	7% (30)
FUTURE TRENDS AND DEVELOPMENTS IN PCE		
Issue	**Users**	**Non-Users**
Future PCE use will increase	33% (9)	64% (270)
Future PCE will remain same	4% (1)	7% (28)
Future PCE use will decrease	4% (1)	0,7% (3)
Future PCE use will be acceptable as use of coffee	40% (11)	42% (186)
More effective PCE drugs will likely be developed	30% (8)	52% (217)
Pharmaceutical companies should be free to focus on PCE drugs	48% (13)	62% (258)
USE OF OTHER POTENTIAL ENHANCEMENT DRUGS		
Issue	**Users**	**Non-Users**
Use of physical enhancement drugs	7% (2)	2% (10)
Use of potential lifespan extension substances	7% (2)	0,5% (2)
Use of mood enhancement drugs	11% (3)	6% (26)

Regarding the question of primary interest, 6,1% (27) of students have answered that they had used PCE drugs (such as MPH, AMP and MDF) with the aim of enhancing concentration, memory, wakefulness, calmness, etc.

(23 of these indicated nonmedical PCE reasons and 4 both nonmedical PCE and medical reasons for use). Concerning gender, a majority of users were female 70% (19), while only 30% (8) were male. Thus the group of users is composed of 27 respondents and the group of nonusers of 418 respondents.

As for the prescription drug of choice, 3 students indicated having used MPH, 4 AMP, 2 bupropion[4] and 1 propranolol,[5] while the rest did not indicate the specific drug used. The primary purpose stated for using PCE drugs was to improve concentration (13), followed by enhancing memory (11), enhancing wakefulness (7), reducing anxiety and fear (5), improving reasoning (4), and enhancing creativity (1). Regarding the effectiveness of PCE drugs, 7 users rated them as moderately effective, 3 as very effective, 3 as ineffective, and 1 as slightly effective. Concerning their side effects, 8 rated them as imperceptible, 4 as mild, 2 as moderate and none as severe. To the question of how often they have used PCE drugs on average, 9 stated that their use was concentrated around specific periods, for example exam periods, ranging from one to five times per year, sometimes daily or on alternate days in a specific period. Further, 3 stated that they had used them at least once weekly and 2 at least once monthly. As for the source from which they received the PCE drug used, 11 listed third persons, 2 listed a medical prescription and 2 the internet. Regarding whether they are still using PCE drugs, 8 stated that they no longer use them because they no longer need them, 3 that they still use them, but to a smaller degree, 2 that they still use them in the same degree, 1 that they no longer use them due to their side effects, 1 because they no longer have access to them, and 1 because no positive effects were noticeable.

Concerning familiarity with the concept or possibility of PCE, 41% (11) of users stated that they were already familiar with the possibility of using prescription drugs to enhance the cognitive functioning of healthy adults before the survey, while roughly the same number of 42% (177) of nonusers stated familiarity.

To the question whether they will ever use PCE drugs in the future, 33% (9) of users responded positively, as did a somewhat lower 21% (87) of nonusers. As to what might increase their probability of future use, 33% (9) of users and 63% (263) of nonusers stated proven efficacy and safety, 15% of users (4) and 26% (107) of nonusers indicated the option if a doctor could prescribe the drugs for the purposes of PCE, 11% (3) of users, and 21% (86) of nonusers indicated the option if their use in society was widespread and

[4] *An atypical antidepressant, also used for the treatment of ADHD.*

[5] *A beta-blocker drug, originally used for the treatment of high blood pressure, but also capable of blunting the negative emotional component of traumatic memories, and of reducing anxiety in social situations or at public performances and appearances, generally inducing calmness.*

generally acceptable. Further, 4% (1) of users and 8% (34) of nonusers indicated increased probability of use if PCE were used by their colleagues or coworkers, 4% (1) of users and 37% (156) of nonusers if their side effects were mild, and 19% (5) of users and 22% (91) of nonusers if they were available over the counter. As to whether they would feel increased pressure to use PCE drugs themselves if the latter were also used by their colleagues or coworkers, 11% (3) of users and 18% (76) of nonusers indicated that they would feel increased peer pressure.

Regarding safety and efficacy, 7% (2) of users and 24% (99) of nonusers were of the opinion that the negative effects of PCE trump their positive effects. When asked to give their opinion of the general efficacy of existing PCE drugs in healthy adults, none of the users and 4% (17) of nonusers rated them as ineffective, 7% (2) of users and 20% (85) of nonusers as slightly effective, 22% (6) of users and 10% (84) as moderately effective and 15% (4) of users and 2% (9) of nonusers as very effective.

Regarding the availability and use of PCE drugs among healthy adults, 26% (7) of users and 20% (82) of nonusers were of the opinion that healthy adults should be permitted to use them according to their own judgment. Concerning possible regulatory actions for addressing the trend of PCE among healthy adults, 11% (3) of users and 54% (226) of nonusers were of the opinion that suitable expert institutions for prescribing and counseling on the use of PCE substances should be established, while 22% (6) of users and 14% (57) of nonusers were of the opinion that the present state of affairs requires no changes, 15% (4) of users and 6% (25) of nonusers expressed support for permitting such use, and none of the users and 7% (30) of nonusers for banning such use.

As for future trends in PCE, 33% (9) of users and 64% (270) of nonusers were of the opinion that the use of PCE substances among healthy adults will most likely increase in the future, 4% (1) of users and 7% (28) of nonusers were of the opinion that it will remain about the same as now, and 4% (1) of users and 0,7% (3) of nonusers of the opinion that it will decrease. Regarding the possibility of an explicit prohibition of PCE drug use among healthy adults in the future, 4% (1) of users and 5% (20) of nonusers considered it likely, while 22% (6) of users and 53% (223) of nonusers considered it unlikely. Further, 40% (11) of users and 42% (186) of nonusers was of the opinion that the use of PCE drugs would in the future generally become as acceptable as the use of caffeine is today.

Regarding future developments in PCE drugs, 30% (8) of users and 52% (217) of nonusers were of the opinion that more effective PCE substances will probably be developed in the future. Further, 48% (13) of users and 62% (258) of nonusers were also of the opinion that pharmaceutical companies should be allowed to perform research and development on

substances that directly target the PCE of healthy people, that is, are directed at enhancement, a direction which is not profitable and desirable for pharmaceutical companies given the current pharmaceutical regulatory system.

Additionally, the survey investigated whether the students had also used pharmaceutical drugs in other fields of potential HET applications, such as to enhance physical abilities, increase healthy lifespan or improve mood and personality dispositions. Regarding physical enhancement, 7% (2) of users and 2% (10) of nonusers indicated that they had used pharmaceutical drugs such as ephedrine, steroids or erythropoietin, for which they had not been given a prescription for the treatment of a diagnosed illness or disorder, in order to increase strength, speed or endurance. Regarding healthy lifespan extension, 7% (2) of users and 0,5% (2) of nonusers indicated that they had used experimental substances, such as resveratrol or KH3, which might increase lifespan or at least the healthspan (Agarwal & Baur, 2011). Regarding mood enhancement, 11% (3) of users and 6% (26) of nonusers had indicated having used drugs for the improvement of mood, such as antidepressives or stimulants, for which they had not been given a prescription for the treatment of a diagnosed illness or disorder.

Discussion: PCE and Contextual Interpretations

The survey on PCE presented above was primarily intended to explore the extent and some details of PCE use among a specific population, in this case undergraduate student at the University of Ljubljana, in the national context of Slovenia, as well as to provide data on some views and opinions regarding PCE among healthy adults.

Enhanced memory, concentration and wakefulness were the primary reasons for PCE drug use, which more than a third of users acquired through third persons. Regarding possible future use, about a third of users and about a quarter of nonusers indicated they will probably use PCE drugs in the future. Conversely, about a third of users stated that they no longer use the drugs because they no longer need them, indicating that the period spent as a student is especially conducive to PCE use, among other factors due to higher academic strain, which is connected to a higher likelihood of prescription stimulant use (Ford and Schroeder, 2009). Perhaps surprisingly, neither the possible general societal acceptability of PCE nor peer pressure figured strongly in the propensities of users and nonusers towards future use.

Several authors (Lucke, 2012; Smith and Farah, 2011) have posed questions on how experiences are similar or different in a cross-cultural or cross-national comparison. The results regarding use of PCE drugs among students in an extensive first-time German survey (Franke et al., 2011) focusing

on stimulant use exclusively for PCE among 512 university students of three University Departments (Medicine, Pharmacy, Economics), showed that the lifetime use of prescription stimulants, such as MPH and AMP for PCE was 0,78%. Compared to the German results, the results of the Slovenian survey on PCE regarding lifetime use of prescription stimulants such as MPH, AMP and MDF is significantly higher at 6,1%, while the number of respondents is comparable (455 Slovenian and 512 German students). The percentage of PCE drug lifetime users is comparable to some of the North American survey results of large samples listed in the introduction (5,4% (2005 survey), 4,1% (2005 survey), 5,9% (2006 survey), 5,3% (2008 survey), 8,9% (2009 survey), 7,5% (2009 survey)), but is generally lower than the results of smaller sample surveys. Interestingly, most (70%) of the Slovenian PCE users were female, in contrast to other studies who find a prevalence of male users (for example, Franke et al., 2011).

Considering the results of our survey we can conclude that some degree of PCE drug use is definitely present, and, though the sample is limited both in size and social representativeness, that a sizeable percentage of respondents is of the opinion that PCE use among healthy adults will likely increase in the future, that more effective PCE substances will probably be developed, and that pharmaceutical companies should be encouraged to perform research and development on substances that directly target cognitive enhancement. Such opinions and attitudes, regardless of their objective validity, can become self-fulfilling prophecies.[6] An important question that emerges in a wider sociocultural framework is what these numbers and opinions signify. There are several possible interpretations that have been proposed.

One interpretation is in terms of the beginnings of a trend or even a culture of enhancement, that is, the increasing personal and societal acceptability and use of a range of scientific and technological interventions aimed at expanding the "normal" or "average" capabilities of healthy people. Indeed, many of the authors that have explored the ramifications of PCE and given public policy recommendations for addressing it have argued in favor of fostering such developments (Bostrom and Sandberg, 2009; Galert et al., 2009; Greely et al., 2008; Mehlman, 2004). In this vein, most surveyed nonusers were of the opinion that suitable expert institutions for prescribing and counseling on the use of PCE substances should be established, and somewhat less than half of users and nonusers were of the opinion that the future acceptability of PCE would be comparable to contemporary caffeine use.

Peterkin, Crone, Sheridan and Wise (2011), building on the results of a survey among 184 college students from the US posit that such developments

[6] *Erroneous or false beliefs and expectations that drive actions and behaviors, which make the false conceptions come true, regardless of the initial actual state of things.*

do not signify a trend of enhancement, as defined in this article, but a form of self-treatment in cases of undiagnosed ADHD. They base their hypothesis on results that show a strong link between stimulant misuse in college students and the presence of symptoms of adult ADHD. Their recommendation is to ensure college students have better accessibility to diagnosis and treatment of ADHD.

But ultimately it is difficult to differentiate between "genuine" enhancement efforts and "purely" therapeutic uses, due to the constant shifting and redefining of societal values, norms and concepts, which are fuelled both by the possibilities opened up through technological innovation as well as by sociocultural trends, and individual and group interests. Namely, what has been regarded as desirable, normal or healthy in the past might not remain such in the future. More pessimistic authors have explored such changes, where an increasing number of conditions and states are being treated through pharmaceutical medication, in the context of "medicalization" (White, 2002: 40–43), and view such shifts primarily as fuelled by the interests and lobbying of large pharmaceutical corporations, resulting in a decrease of individual autonomy and wellbeing. Additionally, increasing pressures and demands at work and in personal life, as well as growing standards of performance and achievement in both areas have undoubtedly contributed to such trends. More optimistic authors see PCE efforts as a continuation of individual and societal strivings to enhance and extend existing capabilities and overcome current boundaries and limitations, which have been present through the history of human civilization.

The benefits, costs and risks of PCE further need to be weighed against the benefits, costs and risks of more "traditional" and established strategies and practices of cognitive enhancement, such as healthy nutrition, physical exercise, adequate sleep, meditation techniques and memorization strategies, as well as against other technological means of cognitive enhancement, such as "brain-training" games and (external) computational devices and software, and generally less "invasive" techniques. Both groups, that is traditional and technological non-pharmacological cognition enhancement techniques, have recently become the subjects of formalized empirical investigation (Dresler et al., 2013). Research and evaluation will need to be conducted in terms of different populations, but also in terms of individual assessment, with regard to ecological niche testing. Of course, all the listed types of cognitive enhancement means might not be mutually exclusive, and might be employed intermittently and strategically.

Still other interpretations see PCE as the continuation of a trend that has been present at least since the chemical revolution at the transition of the 19th to the 20th century, when cocaine and heroin became widely available and lauded as versatile cures and work- and life-enhancing products, and,

from the 1920s onward, followed by the increasing use and prescription of amphetamines. One might also draw a connection with the 1960s counterculture, although the mainstay of the psychotropic drugs used during the "psychedelic revolution", such as LSD, psilocybin and marijuana, were of the psychedelic ("mind-manifesting") instead of the stimulant type, and were mainly employed in seeking alternatives to the existing system and achieving non-ordinary state of consciousness, in the famous words of Timothy Leary, to "Turn on, Tune in, Drop out" (Leary, 1965/1999). Conversely, the goal of modern PCE use seems to be more on productivity and efficiency (and possibly creativity and innovation) within the existing system, by bolstering economically and socioculturally generally valued and desirable states of mind, i.e., attention, concentration, wakefulness and memory. Such orientations and values are generally connected with the capitalist and entrepreneurial mindset, and thus also subject to some critique.

Interpreted in a negative way, in the context of illicit drug (ab)use, the use of prescription drugs for PCE can be seen as comparable to the use of illicit stimulants such as cocaine and various forms of amphetamines and amphetamine-analogues,[7] although, as mentioned, surveys of illicit drug use usually do not single out cognitive or work-performance enhancement use. As Smith and Farah (2011: 736) note, MPH and AMP "both have high potential for abuse and addiction related to their effects on brain systems involved in motivation", which holds to varying degrees for most stimulant substances, including caffeine, when prescribed or recommended dosages are exceeded. Additionally, individual neurological and psychological dispositions, in combination with specific environments, make some individuals more prone to addictive patterns, and there is also strong variation in terms of both positive and negative effects on different individuals within populations. In such a context, the PCE trend might be addressed in the scope of drug abuse prevention and public health policies.

Taking into account the different interpretations of PCE use among students suggested above, it is important how policymakers and political decision-makers decide to view and address modern PCE use, that is, as an issue that pertains to illicit drug abuse, an insufficiently addressed medical issue, a public health or "medicalization" issue, or as an emerging, novel way of enhancing individual and societal performance and addressing contemporary problems and challenges.

[7] *A global UN survey between 2008 and 2010 showed that between 0,3 (13 million) and 0,4 % (19 million) of the world population between 15 and 64 years of age have used cocaine, and between 0,3 (14 million) and 1,2 % (52 million) have used amphetamine-like substances (UNODC, 2012: 1). In the Slovenian context, a national survey in 2011 and 2012 showed that 2,1 % of the population between 15 and 64 years of age have used cocaine, while less than 0,9 % have used amphetamines (IVZ, 2012: 28).*

Sidestepping the issue of differentiating between therapeutic and enhancement use, abuse or novel use, the Ethics, Law and Humanities Committee of the American Academy of Neurology, has issued guidelines for neurologists when responding to adult patients requests for neuroenhancement. The guidance recommendations leave decisions regarding PCE prescriptions up to individual physicians, who should "exercise their clinical and ethical judgment to decide whether to prescribe medications for neuroenhancement" (Larriviere et al., 2009: 1411). Such decisions signal wider changes in the medical sphere and in the doctor-patient relationship, which Chaterjee (2004) has noted in the trend of patients turning to doctors, as consumers intent on obtaining access to enhancements that might improve their quality of life, that is, as social changes in an increasingly enhancement-oriented society.

Conclusion: Future Cognitive Enhancement Research

Ultimately, societies will need to decide in which way to address the (small, but nonetheless present) trend of PCE use. Such decisions will ideally be reached through wide consultation and deliberation between experts, political decision-makers and interest groups, and the wider public and concerned stakeholders, also drawing on empirical findings concerning existing use, as well as opinions and attitudes among different population segments, such as those included in the present PCE survey and other similar studies.

The results of the presented survey also hint at improvements that can be made in future surveys of PCE use, and indicate further research directions. Thus further research on PCE could be conducted among students in other neighboring countries, including both European countries and the Balkans. In this way, it would be possible to explore how far the trend of PCE extends, and whether there are important differences or similarities regarding means, use and goals in various national contexts. Our survey also did not explore the use of illicit drugs ("street drugs") in addition to the PCE use of prescription drugs as did the German survey. A more detailed examination might include demographic data, such as social class and background. More detailed research might explore connections between PCE use and various personality traits and cognitive abilities, or valuations of concepts such as cooperation, competitiveness, work, leisure, perfectionism or novelty seeking, or the presence of ADHD symptoms. Further variables could be academic strain, success or struggling with grades and requirements. Other aspects regarding opinions and attitudes could include ethical and societal aspects of PCE use, such as fairness, equality, distributive justice, cheating, coercion, health and performance. Further exploration could also

be directed at examining the presence of PCE among other population segment, such as cognitive workers, and occupations where attention, wakefulness and concentration are important, such as doctors, policemen and pilots.

Other areas of potential HET application fields, such as the use of pharmaceutical drugs for the enhancement of physical capabilities, healthy lifespan extension or mood and personality modification that have been briefly mentioned in the survey, might also be explored. Further HET applications of interest might be transcranial magnetic stimulation (TMS) or transcranial direct current stimulation (tDSC), which have also shown possible cognition enhancing effects (Chanes et al., 2012.; Kadosh et al., 2012), although such surveys would need to be more directly user-focused, as these technologies are unlikely to be in wide use already. In short, PCE, as well as HE, open up a number of research avenues, either theoretical and conceptual, or empirical. And, at least judging from the interest shown in the scientific literature, and more recently among advisory institutions in the policymaking process, will continue to be a topic of some salience, both from a positive and from a negative perspective.

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