Development of the Attitudes Toward Pharmacological Cognitive Enhancement Scale

A Thesis Submitted to the Committee on Graduate Studies in Partial Fulfillment of the Requirements for the Degree of Master of Arts in the Faculty of Arts and Science

TRENT UNIVERSITY

Peterborough, Ontario, Canada

Psychology M.A. Graduate Program

September 2023

Abstract

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Pharmacological cognitive enhancement is the use of prescription drugs to improve cognitive functioning in healthy individuals. Multiple ethical concerns have been raised by such use. The purpose of this project was to develop a reliable and valid measure to assess public attitudes about this issue. Participants were university students in Studies 1 (N = 465), 2 (N = 580) and 3 (N = 156). In Study 1 principal components analysis reduced the 90-item Attitudes Toward Pharmacological Cognitive Enhancement Scale to 42 items that loaded onto four components: Cheating/Unfairness, Motivation, Expected Benefits and Safety. Subscale scores differentiated users and nonusers. In Study 2 confirmatory factor analyses supported the model and statistically significant associations were found with related constructs such as attitudes toward performance-enhancing drugs, and prescription drug expectancies. In Study 3 test-retest reliability over a 3-week interval was above .70 for 3 of 4 subscales. Implications and future directions are discussed.

Keywords: cognitive enhancement, nonmedical use of prescription drugs, smart drugs, attitudes, scale development

Acknowledgements

I would like to thank my supervisor, Dr. Kevin Peters, for the guidance, encouragement and unwavering support he has given me over the course of this project. I would also like to thank my second reader, Dr. Terry Humphreys, and my external examiner, Dr. Liana Brown, for their help and advice.

To my family, thank you for being supportive and patient throughout this process.

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For millennia, individuals have used various substances to try to enhance their cognitive functioning. Students in ancient Rome rubbed rosemary oil into their foreheads and temples before exams, believing it would improve their memory (Kennedy & Scholey, 2006). Sufi mystics in 15th century Yemen drank coffee to help them stay awake and alert during all night prayer sessions (Weinberg & Bealer, 2001). In the 17th century English gardener and diarist John Evelyn wrote about the power of lemon balm to strengthen memory (Kennedy & Scholey, 2006). From the late 1930s to the 1950s writers such as W. H. Auden, Allen Ginsberg, Jack Kerouac, and Norman Mailer experimented with Benzedrine, an amphetamine available at the time without a prescription, hoping it would improve their creative output (Jacobs, 2012; Rasmussen, 2008).

In the complex and rapidly changing world of the 21st century individuals face increasing demands on their cognitive functioning. As in the past some turn to substances in the hopes of enhancing their cognition. Of particular concern to educators, healthcare providers and others who work with young people is the use of so-called *smart drugs* or *study drugs* by healthy college and university students. Prescription drugs such as those used to treat attention-deficit hyperactivity disorder (ADHD) are being taken without a prescription by some students in the belief that it will increase their ability to concentrate, help them to study for longer periods of time, and improve their academic performance (DeSantis & Hane, 2010; Mitchell et al., 2023; Rabiner et al., 2009; Sabbe et al., 2022). While it is unknown exactly how widespread the practice is, lifetime prevalence rates as high as 43% have been reported in undergraduate samples

(Advokat et al., 2008).

Students are not the only ones engaging in nonmedical use of prescription drugs for cognitive enhancement purposes. In a nation-wide survey of 11,167 employed adults in Germany, Sattler and von dem Knesebeck (2022) reported that 2.6% of participants indicated they had used a prescription drug without a doctor's advice to help with their mental performance in the past year. Of those participants who had misused prescription drugs, 22.7% had done so 40 or more times.

Healthy individuals using prescription drugs to enhance their cognitive functioning has generated considerable controversy and debate among bioethicists, scientists and the media (Brühl et al., 2019; Cakic, 2021; Greely et al., 2008; Racine et al., 2021). Currently prescription drugs are assessed for their safety and efficacy in the treatment of illnesses or disorders, not for enhancement purposes, and there are concerns that the benefits for healthy people may not outweigh the risks (Brühl et al., 2019; Greeley et al., 2008). As with the use of performance-enhancing drugs in sports, there have been debates about whether it is cheating or unfair for healthy students to use drugs that may be cognitive enhancing (Harris, 2011; Mann, 2021; Schermer, 2008). The prospect of the development of more effective cognitive enhancing drugs in the future as knowledge of brain functioning advances has raised concerns about who will have access to these drugs, how free individuals will be to choose whether to enhance or not, how safe these drugs will be for long term use and whether taking them will change fundamental aspects of individuals and society (Brühl et al., 2019; Cakic, 2021; Metzinger & Hildt, 2011; Sandberg, 2011).

In the literature review that follows the difficulties in defining cognitive

enhancement is discussed. The different ways that cognition has been or potentially could be enhanced is then explored. Prescription drugs that have been used in the past as cognitive enhancers and those that are currently being used for that purpose are reviewed. What is known about the prevalence of nonmedical use of drugs for cognitive enhancement and the predictors of such use is explored. The efficacy of the prescription drugs being used for cognitive enhancement purposes is examined, as are the ethical issues surrounding their use in healthy people. The review concludes with a discussion of the research that has been done on the public's attitudes toward pharmacological cognitive enhancement and the factors that affect willingness to enhance.

Defining Cognitive Enhancement

There is no consensus on how to define cognitive enhancement (Forlini, 2022; Maier & Schaub, 2015; Metzinger & Hildt, 2011; Mohamed, 2014). Within the literature one can find various definitions of the term *cognition* such as "the processes an organism uses to organize information" (Bostrom & Roache, 2011, p. 138), and "the neural process of acquiring knowledge and gaining understanding or learning" (Edgren & Dubljević, 2023, p. 47). There are several different ways enhancement has been defined including functional-augmentative, biomedical, and welfarist definitions (Earp et al., 2014; Mohamed, 2014). With functional-augmentative definitions an enhancement is the improvement of a capacity or function so that it is able to do more than it normally does (Earp et al., 2014). A problem with definitions of this sort is that what is considered normal depends on the person or circumstances and can change over time (Earp et al., 2014). Biomedical definitions are based on drawing a distinction between treatment and enhancement with treatment being interventions when there is disease or dysfunction and

the goal is to restore an individual's health, and enhancement being interventions where there is no disease or dysfunction and the goal is to improve an individual's functioning beyond what is needed to maintain their health (Earp et al., 2014; Metzinger & Hildt, 2011; Mohamed, 2014). The difficulty with making such a distinction is that there are different definitions of health and disease, and what is considered a disease can change over time (Metzinger & Hildt, 2011). Welfarist definitions focus on well-being with enhancement being a biological or psychological change that increases the likelihood of living a good life (Earp et al., 2014; Savulescu, 2006). A criticism of welfarist definitions is that there is no agreement about what constitutes a good life (Zohny, 2014).

Despite there being no consensus about how to define cognitive enhancement, there is a need to define it for the purposes of this discussion. Cognitive enhancement will refer to *any intervention where the goal is to improve one or more cognitive abilities (e.g., memory, attention) in a healthy person*. A healthy person will be *a person who does not have a diagnosed illness or disorder.*

Different Strategies for Enhancing Cognitive Functioning

There are many different ways that cognitive functioning has been or potentially could be enhanced (Dresler et al., 2019; Sandberg, 2011). Dresler et al. (2019) grouped these various strategies based on their mode of action. Activities such as sleep, exercise, meditation, musical training, mnemonic techniques (e.g., method of loci) and computer training were included among the behavioral strategies. These strategies are well accepted by society and many of them have a long history of use (Dresler et al., 2019; Sandberg, 2011). Besides pharmaceuticals, other biochemical strategies discussed included various nutritional supplements such as caffeine, glucose, and omega-3 fatty

acids and herbs such as salvia (sage), ginseng and gingko biloba. Nutritional supplements, herbs, energy drinks, and other products available over-the-counter and taken for cognitive enhancement purposes are sometimes referred to as *soft enhancers* (Brühl et al., 2019; Keary et al., 2022; Maier & Schaub, 2015). The use of soft enhancers has received little attention in the literature on cognitive enhancement because their use is generally accepted by society and they are assumed to be safe to use (Keary et al., 2022). Among the physical strategies, Dresler et al. (2019) included deep brain stimulation and brain implants (e.g., Cochlear implants) which are currently only being used in patients with a diagnosed illness or impairment (e.g., Parkinson's disease, hearing impairment), as well as wearable devices (e.g., augmented reality headsets) and other less invasive brain stimulation techniques (e.g., transcranial direct current stimulation) that have been used in lab experiments with healthy people. Whether any of these physical strategies for enhancing cognition will ever be widely used by healthy people remains uncertain. In contrast some healthy people are currently using prescription drugs for cognitive enhancement purposes. It is for this reason and because such use is controversial, that the focus of this discussion will be on pharmacological cognitive enhancement.

Review of Drugs Used for Cognitive Enhancement: Past and Current

Drugs Used in the Past as Cognitive Enhancers: Cocaine and Amphetamines

While a person reading much of the literature on cognitive enhancement might get the impression that healthy people taking pharmaceuticals to try and enhance their cognition is a new phenomenon, there is a long history of such practices (Bell et al., 2012). At the turn of the 20th century cocaine was a heavily marketed drug with doctors prescribing it for a variety of ailments including asthma, toothache, depression, and

morphine addiction (Bell et al., 2012). It was also prescribed to treat overwork and exhaustion, and people taking the drug indicated it improved their ability to perform mental tasks and helped them sustain attention longer (Spillane, 2000, as cited in Bell et al., 2012). As more people used cocaine on a regular basis though for medical and nonmedical reasons, the harmful side effects of the drug began to emerge, prescription rates declined, and laws were enacted to restrict access (Bell et al., 2012).

In the 1930s the American pharmaceutical company Smith, Kline and French began marketing amphetamines as an over-the-counter drug to treat nasal congestion (Benzedrine inhaler) and as a prescription drug (Benzedrine sulfate) to treat depression (Rasmussen, 2008). As early as 1937 doctors in the midwestern United States were warning that university students were abusing Benzedrine sulfate, taking it while studying for exams, and calling the pills *pepper-uppers* or *pep pills* (Rasmussen, 2008). Michael Gazzaniga, a University of California neuroscientist, recalled that as a student in the 1960s his father used to send him Benzedrine to help him with studying (Stix, 2009). Amphetamines were also popular among artists and intellectuals. It is believed that the writer Jack Kerouac wrote an entire novel in 3 days while taking Benzedrine (Rasmussen, 2008).

One of the biggest users of amphetamines for enhancement purposes though was the military. Following testing in 1939 that showed that methamphetamine improved performance slightly on certain mental tasks, German soldiers were issued methamphetamine tablets (Pervitin) during the early months of World War II (Rasmussen, 2008). The Germany military began to question the safety and efficacy of methamphetamine though as reports started coming in of soldiers hallucinating while

under the influence of the drug and of pilots being overconfident, thinking they were performing better than they actually were (Rasmussen, 2008). By the middle of 1941 the drug was only available by prescription and by 1942 German doctors recognized the risk of addiction (Rasmussen, 2008).

All branches of the British and American military issued Benzedrine to combat troops during World War II, but in contrast to the German military, they never lost their enthusiasm for the drug (Rasmussen, 2008). With the exception of a few tasks (e.g., differentiating between a rapidly flashing and a continuous light), the military were unable to show objectively that it improved performance significantly more than caffeine did, despite extensive testing (Rasmussen, 2008). Amphetamines continued to be issued, however, because soldiers felt more self-confident and optimistic and fought more aggressively while on the drug (Rasmussen, 2008). Dexedrine (dextroamphetamine) was given to American soldiers during the Vietnam War for the same reasons, despite concerns that it impaired judgment (Rasmussen, 2008).

By the time of the Vietnam War, however, the widespread use of amphetamines for medical (e.g., depression, weight loss) and nonmedical reasons (e.g., study aid, recreational) had revealed the serious health risks associated with amphetamine use (risk of addiction, dependence, amphetamine psychosis) (Rasmussen, 2008). In 1971 all amphetamines were classified as Schedule II drugs in the United States, making them only available legally by prescription and requiring a new prescription each time more pills were needed (Rasmussen, 2008). The Food and Drug Administration (FDA) placed limits on the quantity of amphetamines that could be manufactured by drug companies in any given year based on medical need (Rasmussen, 2008).

Drugs Currently Being Used as Cognitive Enhancers

Although there are a number of prescription drugs that could be used by healthy people to try and improve their cognitive functioning, only the drugs that are mentioned most often in the cognitive enhancement literature will be discussed. These drugs are amphetamines, methylphenidate, and modafinil.

Amphetamines. Despite attempts to limit the supply and discourage their use in the 1970s, amphetamines are still being used for medical and nonmedical reasons (Rasmussen, 2008). Currently used to treat ADHD, narcolepsy and other sleep disorders, amphetamines are available in Canada under the trade names Adderall (amphetamine/dextroamphetamine), Dexedrine (dextroamphetamine) and Vyvanse (lisdexamfetamine dimesylate) (Canadian Centre on Substance Use and Addiction, 2022). Amphetamines are psychostimulants that increase the amount of dopamine and norepinephrine available in synapses by decreasing their reuptake and at higher doses also increase the amount of dopamine that is released (Groom & Cortese, 2022). Common side effects include headache, reduced appetite, increased heart rate, increased blood pressure, insomnia, restlessness and irritability (Martin & Le, 2022; Schifano et al., 2022).

Methylphenidate. A psychostimulant closely related to amphetamines, methylphenidate is available in Canada under the trade names Ritalin, Concerta and Biphentin (Canadian Centre on Substance Use and Addiction, 2022). Beginning in the 1950s Ritalin was marketed as a treatment for hyperkinetic disorder, a disorder of childhood that would later be known as ADHD (Rasmussen, 2008). Methylphenidate is used primarily in the treatment of ADHD and narcolepsy, but it is occasionally prescribed

off label for other conditions (e.g., fatigue in cancer patients, treatment-resistant depression in the elderly) (Verghese & Abdijadid, 2023). Methylphenidate increases the amount of dopamine and norepinephrine available in the synapse by blocking their reuptake (Verghese & Abdijadid, 2023). Common side effects include headache, dizziness, nausea, reduced appetite, increased heart rate, heart palpitations, insomnia, and nervousness (Verghese & Abdijadid, 2023).

Modafinil. In 1974 two chemists working for the French pharmaceutical company L. Lafon Ltd. discovered a new molecule that they called adrafinil (Billiard & Broughton, 2018). Modafinil is an active metabolite that was identified from the adrafinil molecule in 1976 (Billiard & Broughton, 2018). Modafinil promotes wakefulness and is used in the treatment of disorders that involve excessive sleepiness including narcolepsy, obstructive sleep apnea and shift work sleep disorder (Greenblatt & Adams, 2023). Modafinil decreases the reuptake of dopamine and there is evidence that it effects the levels of norepinephrine, serotonin, glutamate, histamine, orexin and gamma-aminobutyric acid in the brain, but how it promotes wakefulness is not fully understood (Battleday & Brem, 2015; Greenblatt & Adams, 2023). Common side effects include headaches, dizziness, nausea, reduced appetite, diarrhea, rhinitis, anxiety, and insomnia (Greenblatt & Adams, 2023).

Prevalence of Nonmedical Use of Drugs for Cognitive Enhancement

Much of the research on prevalence has focused on the nonmedical use of prescription stimulants among university and college students, so less is known about prevalence in other demographic groups (Faraone et al., 2020). To provide a broader

perspective on this issue, however, what is known about prevalence among secondary school students and adults in the workforce will also be discussed.

Secondary School Students

Two recent studies reported on the nonmedical use of prescription stimulants among secondary school students. McCabe et al. (2023) examined data from the 2005 to 2020 Monitoring the Future surveys, a series of annual surveys on drug and alcohol use among American adolescents. The past-year prevalence of nonmedical use of prescription stimulants was 6.0% for students in grades 8, 10, and 12 from 3,284 schools. Students who attended schools with a higher percentage of students using prescription stimulants for the treatment of ADHD were more likely to engage in nonmedical use, suggesting that many of the nonmedical users were getting the drugs from their peers who had prescriptions. In an earlier review paper, Wilens et al. (2008) found that 16 to 29% of the student participants (elementary school to college) in different studies had been asked to share or sell their prescribed ADHD medications. Among 10,199 secondary school students in Iceland, Gudmundsdottir et al. (2023) found a lifetime prevalence of 5.6%. The motives for nonmedical use were not reported in either study, so some of the nonmedical use may have been for reasons other than cognitive enhancement. Liakoni et al. (2015) examined nonmedical use of drugs for the specific purpose of cognitive enhancement among 1,139 Swiss secondary and vocational school students and found a lifetime prevalence of 9.2% for prescription drugs and 51.3% for soft-enhancers (e.g., energy drinks, caffeine tablets) and a past-year prevalence of 5.9% and 43.4% respectively. The most common motives reported for nonmedical use were to stay awake and to improve concentration.

University and College Students

Among young adults, those attending post-secondary institutions may be at greater risk of nonmedical use of prescription stimulants than their peers who are not attending. Based on data from the 2021 Monitoring the Future survey, Patrick et al. (2022) found that the past-year prevalence of nonmedical use of Adderall was higher for American students enrolled in college full-time (4.3%) than their peers who were not attending college (2.2%). Similar results were found by Ford and Pomykacz (2016) using data from the 2013 National Survey on Drug Use and Health in the United States. Participants between the ages of 18 and 25 who were going to college full-time were 1.28 times more likely to engage in nonmedical use than their peers who were not attending college.

Reported prevalence of nonmedical use of prescription stimulants among university and college students has varied widely across studies. Benson et al. (2015) reviewed 30 studies on misuse among students (mostly American) and found lifetime prevalence rates ranging from 8 to 43% and past-year prevalence rates ranging from 5 to 35%. Based on a meta-analysis conducted with data from 20 of the studies, they estimated the prevalence of misuse to be 17%. In fifteen of the studies the reasons for misuse were reported and the most commonly reported reasons were academic (e.g., to improve concentration). In all 5 of the studies where researchers asked participants where they had obtained the drugs, the most commonly reported source was from other students. Fuermaier et al. (2021) found a lifetime prevalence of 15.9% among 1,071 university students in the Netherlands. Gudmundsdottir et al. (2020) reported a lifetime prevalence of 11.2% in a survey of 521 college students in Iceland. Among 11,630

French-speaking university students in Belgium, Sabbe et al. (2022) found a much lower lifetime prevalence of 4.5%. Mitchell et al. (2023) reported a past-year prevalence of 9.0% in a survey of 3,113 American community college students. Chinneck et al. (2018) surveyed 1,755 Canadian first-year university students and 5.4% indicated they had misused prescription stimulants during the current school term. The majority of users (88%) indicated the drugs were taken to help with their studying.

Some of the nonmedical use of prescription stimulants among university and college students is for reasons other than cognitive enhancement. For example, Sabbe et al. (2022) reported that 7.7% of their participants had taken prescription stimulants to party, while another 5% had taken them to disconnect from reality. A few researchers though have asked their participants about nonmedical use specifically for cognitive enhancement. McDermott et al. (2021) reported a lifetime prevalence of 19.2% for use of cognitive enhancing drugs (prescription and over-the-counter drugs were reported) in a survey of 506 university students in Great Britain. Among 633 Australian university students, Riddell et al. (2018) found a lifetime prevalence of 6.2% for prescription drugs and 2.6% for illegal drugs. Lucke et al. (2018) reported a similar lifetime prevalence of 6.5% for prescription stimulants among 1,136 Australian university students. The past-year prevalence was 4.4%. Surveying three different cohorts of German university students between 2019 and 2021, Dietz et al. (2022) reported past-year prevalence rates of 10.4% (2019), 11.3% (2020) and 8.0% (2021) for prescription and illegal drugs.

Adults in the Workforce

Individuals who engage in nonmedical use of prescription stimulants during their post-secondary studies may continue to do so in the workforce. Holt and McCarthy

(2020) surveyed 212 adults in the United States who had a college degree and had misused prescription stimulants during their college years. The majority of the participants (55%) indicated that they had misused prescription stimulants after college and 13% reported misusing in the previous month. Of those who had misused after college, 69% indicated that their motive was to help them focus better on their work.

Very little research has been done on the prevalence of nonmedical use of prescription drugs for cognitive enhancement purposes among adults in the workforce. Wiegel et al. (2016) surveyed 1,131 university teachers in Germany and found a lifetime prevalence of only 0.88%. Franke et al. (2013) reported a much higher lifetime prevalence of 8.9% for prescription and illegal drug use among 1145 German-speaking surgeons and medical students studying to be surgeons. In a nation-wide survey of 11,167 employed adults in Germany, Sattler and von dem Knesebeck (2022) found a past-year prevalence of 2.6% for prescription drug use. Wolff et al. (2016) reported an estimated past-year prevalence of 15.43% for prescription drug use among 1,186 employed adults in Jordan (723 were teachers).

Although the nonmedical use of drugs for cognitive enhancement is often portrayed as being widespread (e.g., Greeley et al., 2008; Jwa, 2019), exactly how prevalent this use is remains unknown (Bruhl et al., 2019). There is a lack of data on prevalence in the workplace and among older adults. It is difficult to compare the prevalence data that have been published because of a number of methodological issues including differences in how cognitive enhancement and nonmedical use/misuse are defined, the timeframe used (lifetime, past year, past month, current school term), the type of drugs investigated (prescription only, prescription and illegal, prescription and

over-the-counter), the sample recruited (representative or convenience sample, sample size), and whether motives were investigated or not (Bagusat et al., 2018; Forlini, 2022). Lifetime prevalence or past-year prevalence are usually reported in studies, not frequency of use. An individual could take a prescription drug one time to see if it would help them concentrate or remember better, find it ineffective, never do it again, and still be counted among those who enhance.

Predictors and Correlates of Nonmedical Use

A number of factors have been associated with the nonmedical use of prescription stimulants. Demographic characteristics such as being male (Benson et al., 2015; Gudmundsdottir et al., 2023; Kilmer et al., 2021; Sabbe et al., 2022), Caucasian (Arria et al., 2017; Bavarian et al., 2014; Benson et al., 2015; Kilmer et al., 2021) and a member of a fraternity or sorority (Baker et al., 2023; Bavarian et al., 2014; Benson et al., 2015; Cook et al., 2021) have all been associated with nonmedical use, as have various psychological variables including anxiety (Dussault & Weyandt, 2013; Gudmundsdottir et al., 2023; Verdi et al., 2016), depression (Bavarian et al., 2014; Gudmundsdottir et al., 2023; Teter et al., 2010), and self-reported problems with attention (Arria et al., 2011; Gudmundsdottir et al., 2023; Ilieva & Farah, 2019; Rabiner et al., 2009, 2010). In a survey of 843 American college students, Rabiner et al. (2010) found that students who reported greater problems with attention during their first semester of college were more likely to have become nonmedical users by the second semester of their second year. They also found that those who reported greater use of other substances (e.g., alcohol, marijuana, illegal drugs) were more likely to become nonmedical users. The association between nonmedical use and use of other substances has also been reported in cross-

sectional studies (Bavarian et al., 2014; Benson et al., 2015; Kilmer et al., 2021; Sabbe et al., 2022). Individuals with more positive expectancies about the effects of prescription stimulants are more likely to be nonmedical users as well (Arria et al., 2018; Looby & Earlywine, 2010; Lookatch et al., 2012). For example, in a survey of 6,962 American college students, Arria et al. (2018) found that students who believed more strongly that better grades could be obtained by taking prescription stimulants were more likely to be nonmedical users than those who were less sure about the academic benefits. Despite these beliefs, nonmedical users tend to have lower grades than nonusers (Arria et al., 2013; Bavarian et al., 2013, 2014; Benson et al., 2015; Gudmundsdottir et al., 2023).

In studies where drug use for the specific purpose of cognitive enhancement has been investigated, such use has also been associated with males (Champagne et al., 2019; Dietz et al., 2013; Lucke et al., 2018), lower grades (Franke et al., 2011; Lucke et al., 2018), and greater use of other substances (Lucke et al., 2018; Maier et al., 2013; Riddell et al., 2018). Higher levels of perceived stress have been reported in students (Liakoni et al., 2015; Sattler, 2019; Wolff & Brand, 2013) and adults in the workforce (Franke et al., 2013; Wiegel et al., 2016) who engage in nonmedical use for cognitive enhancement. Nonmedical users also tend to have more positive attitudes toward the use of drugs for cognitive enhancement (Champagne et al., 2019; Liakoni et al., 2015; Ott & Biller-Andorno, 2014; Ram et al., 2017; Sümbül-Şekerci et al., 2021) and fewer concerns about safety (Nguyen et al., 2021; Ott & Biller-Andorno, 2014; Sattler & Wiegel, 2013; Sümbül-Şekerci et al., 2021).

Effectiveness of Prescription Drugs in Enhancing Cognition in the Healthy

Healthy people who take prescription drugs for cognitive enhancement evidently

believe that taking these drugs will be effective. The results from two recent meta-analyses suggest though that for individuals who have had adequate sleep any cognitive improvement is likely to be small and limited to certain cognitive functions (Kredlow et al., 2019; Roberts et al., 2020). Roberts et al. (2020) completed 3 meta-analyses comparing the effects of methylphenidate (24 studies), dextroamphetamine (10 studies) and modafinil (14 studies) to placebo on different cognitive functions. For methylphenidate, a small enhancing effect was found on inhibitory control, and small to moderate enhancing effects on recall and sustained attention. No improvements over placebo were found on updating working memory, accessing semantic/long term memory, spatial working memory, selective attention, or switching. No improvements were found for dextroamphetamine. For modafinil, small enhancing effects were found on updating working memory only.

Kredlow et al. (2019) reviewed 19 studies and did a meta-analysis comparing the effects of modafinil to placebo on attention, executive functioning, memory and processing speed. Evidence of small improvements in executive functioning and processing speed were found. No significant improvements over placebo were found for memory or attention. The researchers concluded that modafinil has limited efficacy as a cognitive enhancer in individuals who are not sleep deprived.

While small improvements have been found for certain cognitive functions in some experimental studies, it's less certain that taking these drugs leads to improved performance in real world settings (Roberts et al., 2020). Student who engage in nonmedical use of prescription drugs tend to have lower grades (Franke et al., 2011; Lucke et al., 2018). Arria et al. (2017) investigated the relationship between nonmedical

use of prescription stimulants and academic performance in 898 American college students without ADHD. The grades of nonusers improved significantly between second and third year, but the grades of nonmedical users did not. While the researchers indicated it was possible that nonmedical use prevented the students' grades from decreasing, they didn't gain any obvious academic advantage over other students.

Ethical and Social Issues

Scientists, philosophers and bioethicists have identified a number of ethical and social issues raised by pharmacological cognitive enhancement. These issues are part of a wider debate about the use of drugs and other technologies to enhance various aspects of healthy people (physical appearance and abilities, cognitive abilities, moral behaviour). While some have argued in favour of pursuing any technologies that could potentially improve the quality of people's lives (Harris, 2007; Savulescu, 2006), others fear such technologies will undermine the values of hard work and perseverance and fundamentally change individuals and society (Kass, 2003; Sandel, 2007). Six issues will be discussed: potential benefits, cheating and fairness, safety, authenticity and naturalness, distributive justice, and coercion. An overview of various perspectives on each issue will be provided.

Potential Benefits

Some have argued that the use of drugs to improve cognition in the healthy could offer many potential benefits to individuals and society (Bostrom & Roache, 2011; Sandberg & Savulescu, 2011). Improved cognitive functioning could provide individuals with a greater range of educational, employment and social opportunities, resulting in higher income and improved quality of life (Bostrom & Roache, 2011; Sandberg &

Savulescu, 2011; Tomažič & Čelofiga, 2019). For society, there could be improvements in productivity, greater innovation and advances in science and medicine (Sahakian & Morein-Zamir, 2011; Tomažič & Čelofiga, 2019). Improvements in concentration and alertness could result in fewer traffic accidents and accidents at work, saving money and lives (Sandberg & Savulescu, 2011).

There may be expectations that cognitive enhancing drugs will provide these types of benefits, but there is no conclusive evidence that this is possible with the drugs that are currently available (as reviewed above, Kredlow et al., 2019; Roberts et al., 2020). White (1998) argued that large improvements in cognitive functioning may never be realized because healthy, young people may already be functioning close to what is possible for their brains. Even if significant improvements were possible with cognitive enhancing drugs, not everyone would necessarily benefit. For example, there is some evidence that amphetamines improve the performance of lower functioning individuals, but impair the performance of higher functioning individuals (Colzato et al., 2021). There is also the risk that a drug effective in improving a certain cognitive function (e.g., memory) might have detrimental effects on other cognitive functions (Colzato et al., 2021; de Jongh et al., 2008). If highly effective cognitive enhancing drugs became available, individuals might feel pressured to work longer hours, which could have detrimental effects on their health and family relationships (Sahakian & Morein-Zamir, 2011).

Cheating and Fairness

As with the use of performance enhancing drugs in sports, concerns have been raised that healthy people taking cognitive enhancing drugs, particularly in competitive

situations such as exams, is cheating (Greely et al., 2008; Harris, 2011; Mann, 2021; Schermer, 2008). Several authors have argued that it would only be cheating if there were a specific rule against it (Greely et al., 2008; Harris, 2011). Duke University in the United States has a policy against the nonmedical use of prescription drugs for academic purposes (Duke University, 2022), but most schools do not. Both Greely et al. (2008) and Harris (2011) acknowledged that it might be unfair if only some students have access to such drugs, because they can afford it and other students cannot, but they argue that society already tolerates many forms of unfairness in education (e.g., private tutoring). Kodelja (2021) suggested, however, that just because there are other unfair practices in education is not an adequate justification for allowing nonmedical use in schools.

Safety

All drugs come with the risk of side effects, and the effects of long-term use of prescription drugs for cognitive enhancement are unknown (Brühl et al., 2019; Maslen et al., 2014). Healthy young people may be at particular risk because their brains are still developing (Brühl et al., 2019). Prescription stimulants also come with the risk of addiction and dependence (Maslen et al., 2014). Harris (2011) argued that Ritalin has been prescribed to hundreds of thousands of children for decades with a reasonable safety record and therefore healthy adults should be free to choose whether to take it or not. Greely et al. (2008) suggested that safety concerns could be addressed if there were regulatory changes that would allow drug companies to develop cognitive enhancing drugs for the healthy. Under this approach, the safety and efficacy of the drugs for healthy people would have to be demonstrated before they could be sold to the public.

Authenticity and Naturalness

Ethical issues about authenticity involve concerns about changes to self-identity and the extent to which an individual can take credit for their achievements (Cakic, 2021; Juengst, 1998; Maslen et al., 2014; Metzinger & Hildt, 2011). One perspective is that taking cognitive enhancing drugs will alter fundamental aspects of a person so that they are no longer their true self (Maslen et al., 2014; Metzinger & Hildt, 2011). Other people who have known them may no longer view them as being genuine or may see them as being very different from how they used to be (Metzinger & Hildt, 2011). A different perspective is that cognitive enhancing drugs will give people more control over their lives, help them to achieve their goals and realize their true selves (Maslen et al., 2014; Metzinger & Hildt, 2011). Some have argued that cognitive enhancing drugs undermine important social values such as hard work and perseverance, and individuals are less deserving of their achievements if they obtain them with the help of drugs (Cakic, 2021; Juengst, 1998). There is also the idea that enhancing cognition with drugs is unnatural and less acceptable than more natural methods like education or adequate sleep (Juengst, 1998). In contrast, others have argued that many tools that are already being used to enhance cognition are also unnatural (e.g., computers) and yet they are widely accepted (Greely et al., 2008).

Distributive Justice

There are concerns that cognitive enhancing drugs could exacerbate existing social inequalities within an individual nation, and between wealthier and poorer nations, since only the wealthy may be able to afford them (Metzinger & Hildt, 2011). Government policies could help to mitigate that problem though by encouraging

competition to lower drug prices, and providing financial aid to lower income groups (Sandberg, 2011). Cognitive enhancing drugs could decrease inequalities within a society if the drugs were more effective in improving the cognition of those with lower cognitive ability than those with higher cognitive ability, or if the drugs were only available to those with lower cognitive ability (Metzinger & Hildt, 2011). Providing greater access to cognitive enhancing drugs to socially disadvantaged groups could also help to decrease inequalities in society (Kostick et al., 2020).

Coercion

If safe and effective cognitive enhancing drugs became widely available, concerns have been raised that employees could be forced to take these drugs by their employer as a condition of employment and students could be forced to take them in order to attend school (Farah et al., 2004; Jwa, 2019; Metzinger & Hildt, 2011; Petersen, 2019). This is known as explicit or direct coercion. Some authors have argued that direct coercion might be justified in certain occupations where mistakes can put other people's lives at risk (e.g., surgeons) (Greeley et al., 2008; Petersen, 2019). Even if people are not forced to take cognitive enhancing drugs, they could still feel pressure to take them to compete with others in the workforce or at school who are taking them (Farah et al., 2004; Jwa, 2019; Metzinger & Hildt, 2011; Petersen, 2019). Parents might feel that they have to give these drugs to their children to try and help them be successful (Metzinger & Hildt, 2011). These kinds of pressures are known as indirect or implicit coercion.

Attitudes Toward Pharmacological Cognitive Enhancement

The ethical and social concerns about the nonmedical use of prescription drugs for cognitive enhancement that have just been reviewed reflect the opinions of academics.

Less is known about the public's attitude toward pharmacological cognitive enhancement (Bell et al., 2013; Conrad et al., 2019; Fitz et al., 2014). Knowledge about the public's attitudes is needed, however, to develop appropriate and effective policies about nonmedical use of prescription drugs for cognitive enhancement purposes (Bell et al., 2013; Fitz et al., 2014; Ram et al., 2020). A review of the research that has been done in this area is provided, looking specifically at the opinions of the public about the ethical and social issues that have been debated about in the academic literature.

Potential Benefits

Researchers have found that the public holds diverse opinions on the potential benefits of pharmacological cognitive enhancement. In an online survey of 6,962 American undergraduate students, Arria et al. (2018) found that 28.6% agreed that nonmedical use of prescription stimulants could improve a student's grades, while 33.3% disagreed and 38.0% were unsure. Erasmus and Kotzé (2020) found much greater belief in the academic benefits of nonmedical use of methylphenidate among 353 South African medical students. The majority of the second- (86%) and fifth-year (81%) students believed that methylphenidate could improve the academic performance of individuals who did not have ADHD. Fuermaier et al. (2021) reported that 68% of 1,071 Dutch university students surveyed believed individuals without a prescription could benefit from taking prescription stimulants. Surveying 81 New Zealand psychiatrists, Ram et al. (2021) found that opinions varied on the effectiveness of prescription drugs (methylphenidate, dexamphetamine, modafinil) to enhance cognition with some agreeing they were effective and others disagreeing.

Researchers have found though that nonmedical users tend to have greater belief in the cognitive benefits of prescription drugs than nonusers (Arria et al., 2018; Eickenhorst et al., 2012; Looby & Earlywine, 2010; Lookatch et al., 2012). Arria et al. (2018) found that undergraduate students who had engaged in nonmedical use of prescription stimulants in the previous 6 months were more likely to agree that such use could improve a student's grades than nonusers (64.9% versus 24.1%). In a survey of 547 adults recruited through *Craigslist*, Looby and Earlywine (2010) reported that individuals who had taken prescription stimulants without a prescription during their lifetime expected significantly greater cognitive enhancing benefits than nonusers.

Cheating and Fairness

As with potential benefits, researchers have found a range of opinions as to whether it is cheating or unfair for healthy people to use prescription drugs for cognitive enhancement purposes. Kolar (2015) interviewed 36 Canadian undergraduate students (29 nonusers; 7 nonmedical users of prescription stimulants) and reported that the majority felt that prescription stimulants helped students overcome fatigue and manage time pressures, but did not enhance intelligence or learning ability, and therefore using them was not cheating. They speculated that the students' views might change if the drugs taken were more effective in enhancing cognition. Bell et al. (2013) interviewed 19 students at the University of Queensland in Australia and found that most believed it was cheating for healthy students to use prescription stimulants to help them study. The minority who did not feel it was cheating compared it to drinking coffee or argued that it didn't affect other people. All of the 14 Australian university faculty and support staff members that Dunn et al. (2021) interviewed felt that the behaviour was a health issue

and not an academic integrity issue. They saw it as different than buying essays or plagiarism because students who were taking drugs to help them focus better were still doing the work themselves. Ram et al. (2020) surveyed 414 New Zealand professionals (doctors, nurses, pharmacists, accountants, lawyers) and most participants felt it was unfair for healthy university students to use drugs for cognitive enhancement.

Compared to nonusers, nonmedical users tend to be less likely to view nonmedical use as cheating or unfair (Franke et al., 2012; Ott & Biller-Andorno, 2014; Sümbül-Şekerci et al., 2021). For example, Sümbül-Şekerci et al. (2021) surveyed 1,148 medical, dentistry and pharmacy students in Turkey and found that students who had used prescription stimulants during their lifetime without being diagnosed with an illness were more likely than nonusers to believe such use was morally acceptable. Among 1,035 high school students and 512 undergraduates in Germany, Franke et al. (2012) also found that students who had taken prescription or illegal stimulants for cognitive enhancement purposes in the past were more likely than nonusers to believe that pharmacological cognitive enhancement was fair.

Safety

Concerns about possible side effects as well as the risk of addiction and dependence figure prominently in studies examining public attitudes toward pharmacological cognitive enhancement. Schelle et al. (2014) reviewed 40 such studies and found that medical safety was one of the most common ethical concerns study participants had. Vagwala et al. (2017) conducted focus groups discussions with 66 British undergraduate students and reported that 53 (80.3%) participants gave concern about addiction as a reason for not engaging in pharmacological cognitive enhancement,

while concerns about possible side effects was a reason given by 25 (37.9%) participants. Hiltrop and Sattler (2022) interviewed 12 parents in Germany about their attitudes toward parents giving their children prescription drugs for cognitive enhancement purposes. The parents tended to be very concerned about possible harms to children's health and most could not see any circumstances where they would engage in the practice themselves. Ball and Wolbring (2014) found similar concerns about safety among the 12 Canadian parents they interviewed, half of whom had children with a cognitive disability. Most of the parents felt that for healthy children the possible benefits from cognitive enhancement were outweighed by the risks. Of the 81 New Zealand psychiatrists Ram et al. (2021) surveyed, 19.8% indicated they were asked by university students on a monthly basis to prescribe drugs for cognitive enhancement, but only 6.1% indicated they had done so. Many of participants expressed concerns about possible side effects, the risk of addiction and dependence and possible harm to brains that were still developing. In a survey of 212 American and Canadian physicians, Banjo et al. (2010) also found a lot of concern about the safety of pharmacological cognitive enhancement. Many of the physicians were skeptical about safety claims made by pharmaceutical companies.

Researchers have found that nonmedical users tend to be less concerned about safety than nonusers (Eickenhorst et al., 2012; Gudmundsdottir et al., 2020; Nguyen et al., 2021; Ott & Biller-Andorno, 2014). For example, in a survey of 521 Icelandic college students, Gudmundsdottir et al. (2020) found that those who had misused prescription stimulants during their lifetime were more likely to perceive prescription stimulants as safe to use than nonusers. Nguyen et al. (2021) surveyed 148 university students in England and found that those who had taken prescription drugs to improve

their academic performance during their time at university were more likely to believe the drugs were safe to use than nonusers.

Authenticity and Naturalness

Public attitudes about how pharmacological cognitive enhancement affects the authenticity of achievements have been reported in a few studies. Fitz et al. (2014) recruited 4,011 participants through Amazon's Mechanical Turk and using experimental vignettes found that an employee's work performance was viewed as significantly less authentic when a cognitive enhancing drug was taken than when it wasn't. The employee was also viewed as less worthy of promotion when they were enhanced. Maier et al. (2015) surveyed 3,056 Swiss university students and reported that 68% of the participants felt that any performance achieved using pharmacological cognitive enhancement was not as worthy of recognition. Keary et al. (2022) asked 113 Irish university students to rate the authenticity and worthiness of a hypothetical university scholarship applicant taking different types of cognitive enhancing substances. They reported that the mean ratings for the authenticity of the student's performance and their worthiness of receiving the scholarship were on the positive side for the pharmacological cognitive enhancement condition, indicating that the students did not feel that nonmedical use undermined authenticity or worthiness.

Several researchers have found differences in the attitudes of nonmedical users compared to nonusers on the question of authenticity. Maier et al. (2015) found that Swiss university students who had engaged in pharmacological cognitive enhancement were less likely to think it affected the worthiness of a performance. Ott and Biller-Andorno (2014) surveyed 1,765 Swiss university students and reported that students who

had taken Ritalin, Adderall or modafinil for cognitive enhancement during their lifetime were significantly less likely than nonusers to indicate they would no longer be proud of their achievements if they used drugs for cognitive enhancement (18.5% versus 42.4%).

There is some evidence that the public is more accepting of enhancements that they view as more natural (Ball and Wolbring, 2014; Scheske and Schnall, 2012). In two studies, Scheske and Schnall (2012) found that University of Cambridge undergraduate and graduate students ($N_1 = 50$; $N_2 = 306$) judged the use of a cognitive enhancing drug more acceptable when the drug was described as natural instead of artificial. Many of the parents that Ball and Wolbring (2014) interviewed were more accepting of using natural products (e.g., nutritional supplements, vitamins) for cognitive enhancement rather than pharmaceuticals. Most of the parents viewed natural products as being safer to use.

Distributive Justice

The public's attitudes about concerns that unequal access to cognitive enhancing drugs might result in greater inequality in society have been investigated in several studies. Maier et al. (2015) reported that 55% of the Swiss university students they surveyed agreed that unregulated access to cognitive enhancing drugs could lead to inequality in educational and employment opportunities, while 23% disagreed and 22% were unsure. They also found that those who had engaged in pharmacological cognitive enhancement were less likely to agree that unregulated access could lead to inequality than nonusers. In one study Scheske and Schnall (2012) found that the University of Cambridge students they surveyed judged the use of cognitive enhancing drugs most moral when most people could afford to buy the drugs and least moral when only a few people could. In their second study though, they did not find a significant difference in

the participants' moral judgements. They suggested that the students may have been less concerned about distributive justice issues because many of them came from wealthy backgrounds. Fitz et al. (2014) found that the participants they recruited from Amazon's Mechanical Turk felt it was less fair if a student was able to purchase a cognitive enhancing drug because of their family's wealth rather than if they had earned the money themselves working during the summer. Keary et al. (2022) reported that their Irish university student participants tended to judge it as unfair if one student could afford to purchase a pharmacological cognitive enhancer to help them prepare for an entrance exam and another could not.

Coercion

Researchers have investigated public attitudes about the risks of direct and indirect coercion with pharmacological cognitive enhancement. In a survey of 80 participants (mostly university students), Maslen et al. (2015) found that 62% disagreed or strongly disagreed that individuals in professions where their actions could cause the death of another person (e.g., surgeons) had a moral duty to take cognitive enhancing drugs. While 58% of the university students in the Maier et al. (2015) study believed that individuals were free to decide for themselves whether to take drugs for cognitive enhancement, 48% agreed that unregulated access to cognitive enhancing drugs would put pressure on people to use them. Nonmedical users were significantly more likely than nonusers to agree that individuals were free to decide for themselves whether to take drugs for cognitive enhancement, but there was no significant difference in the percentages that agreed that unregulated access would put pressure on people to use cognitive enhancing drugs. Forlini and Racine (2009) conducted interviews with separate

focus groups of Canadian university students (n = 29), parents of students (n = 21) and healthcare providers (n = 15) and reported that the majority of the participants felt that the decision to enhance or not was voluntary. Most of them acknowledged though that there is a lot of pressure on students to be successful. Some of the parents in the Hiltrop and Sattler (2022) study thought that societal pressures for children to perform well academically could lead to some parents giving their children cognitive enhancing drugs. None of the parents interviewed admitted that such pressures would affect them though. They may have been providing socially desirable answers. In contrast, in the Ball and Wolbring (2014) study a few parents indicated they might look into cognitive enhancing drugs for their children if they felt their child was being put at a disadvantage because other children were using them.

Factors that Affect Willingness to Enhance

A number of researchers have investigated factors that affect the public's willingness to use cognitive enhancing drugs. Among the German high school students and undergraduate students Franke et al. (2012) surveyed the main factors that affected willingness to enhance were the risk of side effects, addiction, and long-term impacts on health. In terms of side effects, 82.2% of students indicated that they would not use a cognitive enhancing drug if there were any risk of side effects and 81.6% indicated there would have to be no risk of addiction or long-term negative effects on health. Some students (15.6%) indicated they would not use cognitive enhancing drugs under any circumstances. Pressure from others was a factor for some students as 7.5% indicated they would use if they had friends who took cognitive enhancing drugs, and 5.7% indicated they would if their employer recommended it to them. The researchers did not

ask specifically about whether cost would be a factor, but a blank space was provided to list other factors and 1.9% indicated that the drugs would need to be inexpensive. Safety was also a major consideration for the 1,852 German university students Sattler et al. (2013) surveyed. The students were much more willing to use a hypothetical cognitive enhancing drug when the side effects were mild or moderate rather than severe, and the risk of side effects was 1 in 10000 users rather than 1 in 10. They also were more willing to enhance if all students were using the drug rather than only half the students or only one student, and when the university had no policies about the use of cognitive enhancing drugs rather than when they did (penalties or not). Severity of side effects did not affect the willingness to use a hypothetical cognitive enhancing drug among the 2,877 German university students recruited by Sattler et al. (2014), but the probability of side effects did. The students were less willing to take the drug if the probability of side effects was high, the price of the drug was high, and society was disapproving of use. The students were more willing if the efficacy of the drug was high, the probability of cognitive enhancement was high, and every peer or every second peer was using it rather than none. Huber et al. (2023) also found that peer use and other people's judgments about the moral acceptability of use affected willingness to enhance among the 13,443 German adult nonusers they surveyed. The participants who had more friends who engaged in the behaviour and who believed that people close to them would approve of nonmedical use of prescription drugs for cognitive enhancement purposes indicated greater willingness.

As with academics, the public appears to hold a range of opinions on whether it's acceptable for healthy adults to take prescription drugs for cognitive enhancement and under what circumstances. Much of the research in this area has focused on the attitudes

of students, with very few studies investigating the attitudes of other groups (e.g., working adults, retirees) (Schelle et al., 2014). What is clear from the research is that nonmedical users tend to expect greater benefits from pharmacological cognitive enhancement and tend to be less concerned about ethical issues such as safety and cheating and fairness than nonusers (Arria et al., 2018; Eickenhorst et al., 2012; Looby & Earlywine, 2010; Schelle et al., 2014). It is difficult to compare the results from different studies though because researchers each use their own questionnaires in their studies.

Currently, there is no reliable and valid scale available to researchers to measure attitudes toward pharmacological cognitive enhancement. The development of such a scale would be a benefit to researchers for a number of reasons. One of the difficulties in comparing results from different studies is that researchers use different definitions for terms such as drugs. Drugs may refer to illegal and prescription drugs (e.g., Franke et al., 2012), prescription drugs only (e.g., Nguyen et al., 2021), or a particular class of prescription drugs such as stimulants (e.g., Gudmundsdottir et al., 2020). A scale would provide standardized definitions for such terms as drugs, healthy and cognitive enhancement. There is a need for more information on public attitudes toward pharmacological cognitive enhancement in order to develop appropriate policies regarding their use (Bell et al., 2013; Fitz et al., 2014; Ram et al., 2020). A reliable and valid scale to measure such attitudes would be a useful tool in helping to build empirical knowledge in this area. Much of the research on attitudes has been done with university and college students in the United States and Europe and less is known about attitudes in other groups (Hiltrop & Sattler, 2022; Schelle et al., 2014). Studying attitudes in working adults or cross-cultural differences in attitudes would be easier if there was a single

measure that researchers could use, provided that the factor structure of the scale was consistent across different populations.

Development of the Attitudes Toward Pharmacological Cognitive Enhancement Scale

The primary purpose of this project was to develop a scale to assess individuals' attitudes toward pharmacological cognitive enhancement (ATPCE Scale). As part of the development of the scale a number of terms had to be defined for potential participants. Pharmacological cognitive enhancement was defined as healthy individuals using drugs to enhance their cognitive abilities. Healthy was defined as individuals who do not have any cognitive disorders or learning disabilities such as Alzheimer's disease or attention-deficit hyperactivity disorder. Drugs was defined as current or future prescription drugs that can be obtained legally from a doctor. Cognitive abilities was defined as the ability to remember, pay attention or solve problems.

After a thorough review of the literature on pharmacological cognitive enhancement, Dr. Kevin Peters created an initial pool of 90 items for the ATPCE Scale. These items were developed to measure attitudes in seven different areas: expected benefits for individuals and society from the use of cognitive enhancing drugs (Expected Benefits); how motivated is the individual to use cognitive enhancing drugs (Motivation); is it cheating or unfair for healthy individuals to use cognitive enhancing drugs (Cheating/Fairness); would using cognitive enhancing drugs affect self-identity, the meaning of achievement or naturalness (Authenticity/Natural); should or would cognitive enhancing drugs be available to everyone (Distributive Justice); will there be social or

peer pressure to use cognitive enhancing drugs (Coercion); and concerns about the safety of using cognitive enhancing drugs (Safety/Trust).

Legal issues surrounding the use of prescription drugs without a prescription were not addressed in the scale items. There are healthy individuals who might want to use prescription drugs to improve their cognition and would be willing to break the law to obtain those drugs. There are other individuals who might want to use prescription drugs to improve their cognition, but would not willing to break the law to obtain them. The scale items were developed to measure individuals' attitudes toward the use of cognitive enhancing drugs, regardless of how they might feel about breaking the law.

Three studies were conducted to assess the reliability and validity of the ATPCE Scale. In Study 1 participants completed the initial pool of 90 ATPCE Scale items and principal components analysis was conducted to explore the underlying structure of the scale and to reduce the number of scale items. Some initial testing of the construct validity of the scale was also performed. In Study 2 participants completed the revised ATPCE Scale as well as measures to assess ethical ideologies, attitudes toward doping in sports, prescription drug expectancies, perceived stress and satisfaction with current cognitive abilities and academic performance. Confirmatory factor analysis was conducted on the revised ATPCE Scale data to assess how well the scale structure identified in Study 1 fit the data from an independent sample. The relationships between the ATPCE scale and the other measures were examined to further assess the construct validity of the scale. In Study 3 participants completed the revised ATPCE Scale at two different time points a minimum of 3 weeks apart to assess the test-retest reliability of the scale.

Study 1

The purpose of Study 1 was to recruit a large number of participants to complete the initial pool of ATPCE Scale items and to perform principal components analysis on the data to explore the underlying structure of the scale and to produce a smaller pool of items that could be used in subsequent stages of the project. As the initial pool of items was developed to measure attitudes in seven different areas (Expected Benefits, Motivation, Cheating/Fairness, Authenticity/Natural, Distributive Justice, Coercion, Safety/Trust), it was expected that seven components would be identified through principal components analysis.

To do some initial testing of the construct validity of the ATPCE Scale the scores of users (had taken a prescription drug without a prescription or an over-the-counter drug for cognitive enhancement purposes) were compared to nonusers (had not taken a prescription or over-the-counter drug for cognitive enhancement purposes) on each of the components identified through principal components analysis. Also correlational analyses were performed between the participants' scores on each of the components identified and how much they were willing to spend per month on a safe and effective cognitive enhancing drug.

Method

Participants

A total of 589 undergraduate students at the Peterborough and Oshawa campuses of Trent University participated in the study. They were recruited from first-year introductory psychology courses and second-year research methods and statistics in psychology courses using an online participant management system (SONA). After

screening the data for inappropriate responding (did not correctly answer 2 strike questions that required a specific response), 74 participants' (12.56%) data were excluded from further analyses. Data from an additional 50 participants (8.49%) were excluded as data were missing for the variables of interest. The final sample consisted of 465 participants (78.95%). Demographic information for the final sample is provided in the Results. The Research Ethics Board of Trent University approved this study. Participating students were compensated with a 1.0 bonus course credit. Students who chose not to participate in psychology research projects were given the option to complete a written report for bonus course credit.

Measures

Attitudes Toward Pharmacological Cognitive Enhancement Scale (ATPCE). In part 1 participants were asked to provide demographic information (age, gender, university year, current living arrangement, employment status, household income level, and ethnicity) (Appendix A). Participants were also asked if they have ever taken a prescription or over-the-counter drug to enhance their cognitive functioning. If "Yes" was selected, they were asked to list the drug. Due to a problem with participants listing multiple drugs at one time, this question was reworded one week into the study to indicate that only one drug should be listed at a time. For each drug participants were asked about past year use, frequency of use, where the drug was obtained, the drug's effectiveness, and if any unpleasant side effects were experienced. Participants could list and provide information for up to five drugs.

Part 2 of the questionnaire contained the initial pool of 90 Attitudes Toward Pharmacological Cognitive Enhancement Scale items developed by Dr. Kevin Peters for

this study. These items were developed to measure attitudes in seven areas: 19 items on expected benefits for individuals and society from using cognitive enhancing drugs (Expected Benefits); 14 items about how motivated an individual is to use cognitive enhancing drugs (Motivation); 11 items on whether it is cheating or unfair for healthy individuals to use cognitive enhancing drugs (Cheating/Fairness); 13 items on how use might affect self-identity and the meaning of achievement and whether it is unnatural to use drugs to enhance cognition (Authenticity/Natural); 11 items about who would or who should have access to cognitive enhancing drugs (Distributive Justice); 10 items dealing with social or peer pressure to use cognitive enhancing drugs (Coercion); and 12 items on the safety of using cognitive enhancing drugs (Safety/Trust). Two additional items tested for inappropriate responding (strike questions that required a specific response). Items were rated on a 7-point Likert scale with participants asked to indicate how strongly they agreed or disagreed with each statement (Strongly Disagree to Strongly Agree). At the end of the questionnaire participants were asked to list the benefits they would expect to gain if a safe and effective drug was available to enhance their cognitive abilities and to indicate how much they would be willing to pay per month for such a drug at increments of $10-per-month ($0 to $100 or more).

The Eysenck Personality Questionnaire – Brief Version (EPQ-BV).

Developed by Sato (2005), this 24-item questionnaire is designed to assess two different personality traits: Extraversion (12 items) and Neuroticism (12 items). Participants are asked to rate on a 5-point Likert scale the extent to which each item describes them (Not at All to Extremely). Adequate validity and test-retest reliability have been demonstrated (Sato, 2005). Data from this measure were not analyzed as part of this thesis.

Narcissistic Personality Inventory-16 (NPI-16). Developed by Ames, Rose, and Anderson (2006), the NPI-16 is a measure of overt narcissism and includes 16 items taken from the 40-item Narcissistic Personality Inventory. For each item participants are asked to select which statement from a pair of statements best describes their feelings and beliefs about themselves. The scale has been shown to have adequate validity and test-retest reliability (Ames, Rose, & Anderson, 2006). Data from this measure were not analyzed as part of this thesis.

The Balanced Inventory of Desirable Responding (BIDR). Developed by Paulhus (1988, 1991), the 40-item BIDR consists of two scales that assess different aspects of social desirability. The Impression Management (20 items) subscale assesses an individual's tendency to over-report socially desirable behaviours and under-report socially undesirable behaviours. The Self Deception (20 items) subscale assesses an individual's tendency to exaggerate their positive attributes. Participants are asked to rate on a 7-point Likert scale (Not True to Very True) the extent to which they agree with each statement. The BIDR has been shown to have adequate validity, internal consistency, and test-retest reliability (Paulhus, 1988, 1991). Data from this measure were not analyzed as part of this thesis.

Procedure

Students were notified of the opportunity to participate in the study through the psychology department's online participant management system (SONA). A brief description of the study was provided and potential participants were advised it would take approximately 60 minutes to complete the study online. Individuals who wished to participate clicked on the link provided and were taken to the Qualtrics Survey System

website to complete a consent form (Appendix B). Those who clicked *Agree* on the consent form had an opportunity to complete the four questionnaires. The ATPCE Scale questionnaire was presented first, then the BIDR, the NPI-16 and finally the EPQ-BV. When the participant had completed all of the questionnaires or they had withdrawn, a debriefing form (Appendix C) was provided to explain the purpose of the study and to provide contact information for the researchers and for counselling services, if needed.

Data Analysis

Data analyses were performed in R (Version 3.2.2; R Core Team, 2015). Means, standard deviations and item-to-item correlations were examined for each of the 90 ATPCE Scale items to determine if any items should be removed prior to conducting principal components analysis. Principal components analysis was conducted using the *psych* package (Version 1.5.8; Revelle, 2015), the *corpcor* package (Version 1.6.8; Schafer et al., 2015) and the *GPArotation* package (Version 2014.11-1; Bernaards & Jennrich, 2005) to determine if there was any support for the seven proposed subscales and to reduce the number of items. In addition to examining the scree plot, Horn's parallel analysis was conducted using the *paran* package (Version 1.5.1; Dinno, 2012) to determine the number of components to extract. Oblimin and promax rotations were performed as it was expected that some of components would be correlated. Cronbach's alpha statistics were calculated for each of the components to assess internal consistency.

Some initial testing of the construct validity for the revised ATPCE scale was performed. For these analyses normality was assessed for each variable by examining the histogram for the variable and the normal Q-Q plot. Boxplots were used to look for potentially influential outliers. For analyses that involved comparing the means of two

groups, homogeneity of variance was assessed using the Brown–Forsythe test. For bivariate analyses scatterplots were examined to assess if there was evidence of a linear or monotonic relationship between the variables. The mean score of users (had taken a prescription drug without a prescription or an over-the-counter drug for cognitive enhancement purposes during their lifetime) was compared to nonusers (had not taken a prescription or over-the-counter drug for cognitive enhancement purposes during their lifetime) on each of the components using *t*-tests. Two-tailed t-tests were used. Cohen's *d* was used to measure effect size. Also Spearman's correlation coefficients were calculated between the participants' scores on each of the components and how much they were willing to spend per month on a safe and effective cognitive enhancing drug. Confidence intervals were determined using bias-corrected and accelerated (BCA) bootstrapping (2000 samples were used).

Results

Demographics of the Sample

Demographic information for the 465 participants is provided in Table 1. The participants ranged in age from 17 to 59 years ($M = 21.53$, $SD = 6.23$) and most were female ($n = 381$, 81.94%), white ($n = 372$, 80.00%) and in their first ($n = 234$, 50.32%) or second year ($n = 118$, 25.38%) of university. The majority of the participants were living off-campus with roommates ($n = 150$, 32.33%) or their family ($n = 128$, 27.59%). Most were currently unemployed ($n = 273$, 58.71%) or only working part-time ($n = 161$, 34.62%). Reported household income varied with the two largest groups of participants representing the highest and lowest income levels. Participants with a reported household income under $10,000 a year comprised 26.42% ($n = 121$) of the sample,

Table 1

Demographic Characteristics of Sample Study 1 (N = 465)

Characteristic	*M* (*SD*)	*n*	%
Age	21.53 (6.23)		100.00
Gender			
Male		84	18.06
Female		381	81.94
Year of university			
1st year		234	50.32
2nd year		118	25.38
3rd year		63	13.55
4th year		31	6.67
5th year and beyond		19	4.09
Currently living (*n* = 464)			
At home with your family		128	27.59
On campus		125	26.94
Away from home with roommate(s)		150	32.33
Away from home with romantic partner		31	6.68
Away from home on your own		30	6.47
Current employment status			
Working full-time		31	6.67
Working part-time		161	34.62
Not working		273	58.71
Household income level (*n* = 458)			
Under $10,000		121	26.42
$10,000 to 19,000		36	7.86
$20,000 to 29,000		19	4.15
$30,000 to 39,000		24	5.24
$40,000 to 49,000		22	4.80
$50,000 to 59,000		31	6.77
$60,000 to 69,000		35	7.64
$70,000 to 79,000		32	6.99
$80,000 to 89,000		29	6.33
$90,000 to 99,000		30	6.55
Over $100,000		79	17.25
Ethnicity			
Caucasian/White		372	80.00
Indigenous/First Nations		3	0.65
African/Black		26	5.59
Asian/Pacific Islander		34	7.31
Hispanic/Latino		6	1.29
Other		24	5.16

Note. Percentages may not add up to 100% due to rounding.

while those with a household income exceeding $100,000 made up 17.25% (*n* = 79). As many of the participants were living at home with their family, some participants may have reported their parents' income rather than their own personal income.

Drug Use to Improve Cognitive Functioning

Information on the participants' use of prescription and over-the-counter drugs to improve their cognitive functioning is provided in Table 2. Of the 465 participants, 61 (13.12%) indicated they had taken a prescription or over-the-counter drug during their lifetime to try to improve their cognition. Although not reported in Table 2, the most commonly reported prescription drugs used were Adderall (*n* = 13, 21.31% of lifetime users), Ritalin (*n* = 9, 14.75% of lifetime users) and Concerta (*n* = 9, 14.75% of lifetime users). Ritalin and Concerta are trade names for methylphenidate and Adderall is a trade name for a mixture of amphetamine and dextroamphetamine. The most commonly reported over-the-counter drugs used were ginseng (*n* = 13, 21.31% of lifetime users) and gingko biloba (*n* = 7, 11.48% of lifetime users). A few participants listed drugs that were unexpected (e.g., over-the counter pain reliever Advil, prescription bronchodilator salbutamol which is used to treat asthma). It's unclear if these participants were using these drugs to improve their cognition or if they had misread or misunderstood the question. The majority of the lifetime users reported use of only one type of drug, prescription only (*n* = 32, 52.46%) or over-the-counter only (*n* = 22, 36.07%).

The question where participants were asked to list the drug they had taken to improve their cognitive functioning was reworded one week into the study to make it clearer that only one drug should be listed at a time. Four of the 31 participants who completed the study before the change was made listed multiple drugs. An additional 3

Table 2

Characteristics of Drug Use to Improve Cognitive Functioning Study 1 (N = 465)

Characteristic	*n*	%
Lifetime use		
Yes	61	13.12
No	404	86.88
Type of drug used (*n* = 61)		
Prescription only	32	52.46
Over-the-counter only	22	36.07
Prescription and over-the-counter	6	9.84
Prescription and illicit	1	1.64
Past year use		
Yes	43	9.25
No	422	90.75
Frequency of use if used in the past year (*n* = 43)		
Daily	24	55.81
Once a week	4	9.30
Once a month	5	11.63
Less than once a month	10	23.26
Drug effective in enhancing cognition (*n* = 61)		
Yes	44	72.13
No	17	27.87
Experienced unpleasant side effects (*n* = 61)		
Yes	26	42.62
No	35	57.38
Source of drug (*n* = 61)		
A doctor prescribed it to me	19	31.15
A friend	21	34.43
A pharmacy	17	27.87
A health food store	11	18.03
Parent gave it to me	2	3.28
The internet	2	3.28
Other	8	13.11

Note. Percentages for Source of drug add up to more than 100% because participants could list multiple drugs and multiple sources for each drug.

participants listed multiple drugs after the question was reworded. For these participants

it was not possible to determine which drug they were referring to when they answered questions about past year use, frequency of use, source, effectiveness and side effects. Due to this issue the responses to these questions were analyzed based on all of the drugs listed by each participant.

Of the 465 participants, 43 (9.25%) indicated they had taken a drug to improve their cognitive functioning in the past year. The majority of these participants (n = 24, 55.81%) were taking at least one of the drugs they listed daily. Others (n = 10, 23.26%) used only occasionally and their highest frequency of use for any of the drugs they listed was less than once a month. Most (n = 44, 72.13%) of the lifetime users indicated that at least one of the drugs they had taken had been effective in improving their cognition. Unpleasant side effects had been experienced by 26 (42.62%) of the lifetime users. The most commonly reported side effects included headaches, loss of appetite, gastrointestinal problems, dry mouth, insomnia, restlessness, and irritability.

Drugs were obtained from a variety of sources. Friends were the most frequently reported source for drugs (n = 21, 34.43% of lifetime users). Nineteen of the 21 participants who reported friends as a source, had obtained at least one prescription drug from friends. Other nonmedical sources of prescription drugs included the internet and drug dealers. Most of the over-the-counter drugs were obtained from health food stores or pharmacies.

Based on the sources from which prescription drugs were obtained, 22 participants (4.73%) were nonmedical users. They had reported taking at least one prescription drug without a prescription to improve their cognitive functioning. Seventeen participants (3.66%) were medical users. They had reported a prescription for

all of the prescription drugs they had taken to improve their cognitive functioning. An additional 22 participants (4.73%) were over-the-counter drug users. They had reported taking only over-the counter drugs to improve their cognitive functioning.

Expected Benefits from a Safe and Effective Cognitive Enhancing Drug

The participants were asked to describe the benefits they would expect to gain if there were a safe and effective drug that could enhance their cognitive functioning. A response to this question was provided by 448 of the 465 participants. Some examples of the types of benefits mentioned include improvements in memory, greater ability to concentrate, better problem solving skills, greater productivity, increased motivation, faster processing of information, increased alertness, better grades, greater creativity, more free time, better careers, less stress and decreased likelihood of developing dementia in the future. No benefits were expected by 23 participants (5.13% of respondents). Twenty-eight participants (6.25% of respondents) indicated that they would not take a cognitive enhancing drug. Some of the reasons given for not wanting to take such a drug included concerns about possible side effects, that it would be cheating to take a cognitive enhancing drug and that any work done wouldn't be their own accomplishment.

Motivation to Use a Safe and Effective Cognitive Enhancing Drug

To measure how motivated participants might be to use a safe and effective cognitive enhancing drug, participants were asked how much money they would be willing to spend per month for such a drug. They were given the option to indicate they were not interested in taking a drug to enhance their cognitive abilities or to select an amount from 11 possible options. The results are presented in Table 3. Almost half of

Table 3

Amount Willing to Spend per Month for a Safe and Effective Cognitive Enhancing Drug Study 1 (N = 465)

Option	*n*	%
I am not interested in taking a drug to enhance my cognitive abilities	228	49.03
$0 to $9	38	8.17
$10 to $19	58	12.47
$20 to $29	41	8.82
$30 to $39	25	5.38
$40 to $49	22	4.73
$50 to $59	21	4.52
$60 to $69	8	1.72
$70 to $79	3	.65
$80 to $89	3	.65
$90 to $99	3	.65
$100 or more	15	3.23

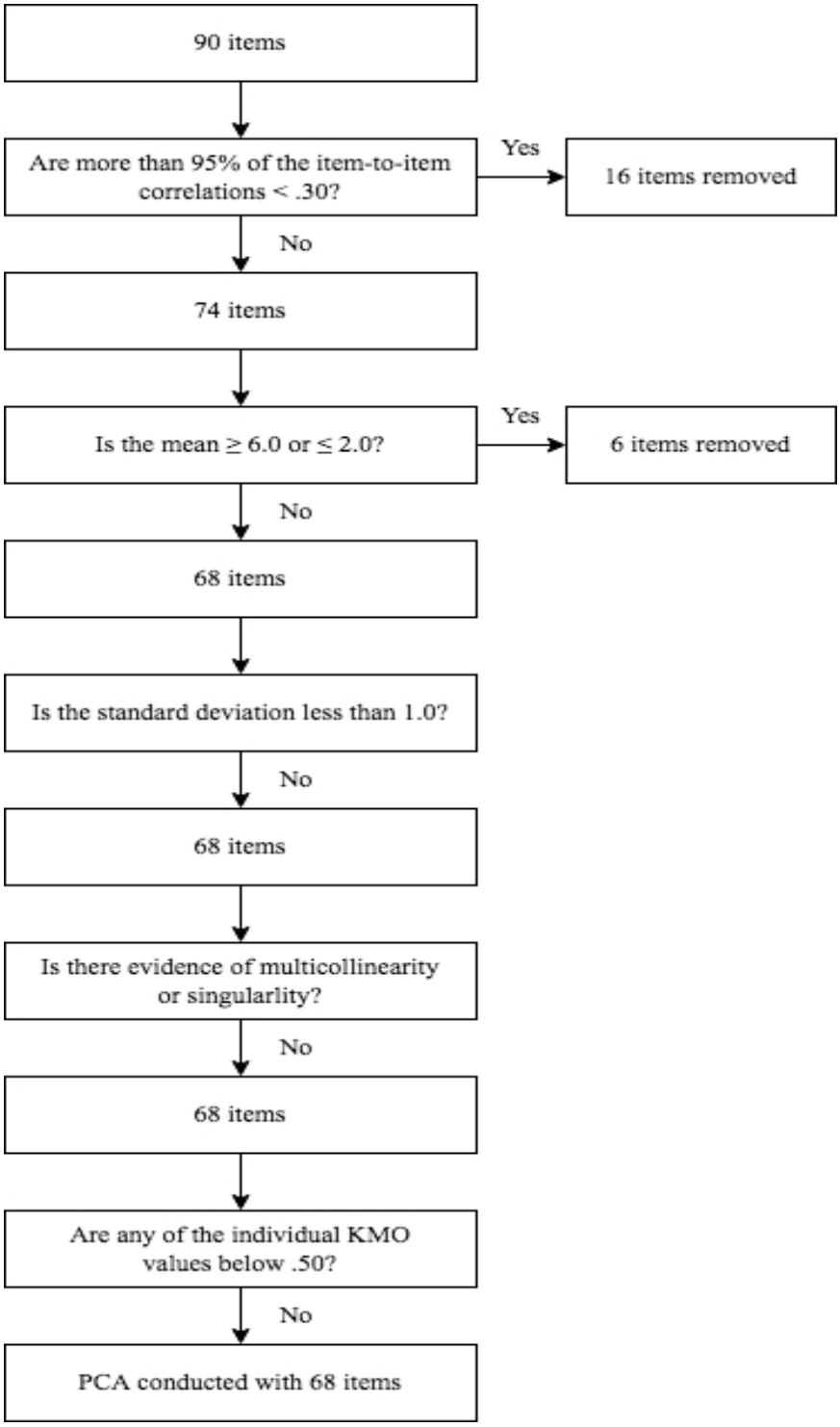
the participants (*n* = 228, 49.03%) indicated they were not interested in taking a drug to enhance their cognitive abilities. This suggests that many of the participants had very low motivation to use cognitive enhancing drugs. Most of the remaining participants were willing to spend less than $60 a month (*n* = 205, 44.09%). Only 15 participants (3.23%) indicated they would be willing to spend $100 or more a month.

Principal Components Analysis

The process used to select which of the ATPCE scale items would undergo principal components analysis is outlined in Figure 1. The correlation matrix of the 90 ATPCE scale items was examined to determine the strength of the correlations among them. Field et al. (2012) suggested removing variables if most of the item-to-item correlations were less than .30. Sixteen items were removed as in each case more than 95% of the item-to-item correlations were less than .30.

Figure 1

Process to Determine if Any Items Would Be Removed Before Conducting Principal Components Analysis



As recommended by DeVellis (2012), the means and standard deviations of the items were examined to assess normality and to determine if there was sufficient variability to perform principal components analysis. A visual inspection of the histograms for the scale items revealed that some items were highly positively or negatively skewed. Items were removed if the means were greater than or equal to 6.00 or less than or equal to 2.00. This resulted in 6 more items being removed. The remaining 68 items all had standard deviations above 1.0, indicating that there was some variance in the data.

The data were also examined for evidence of multicollinearity and singularity. Multicollinearity occurs when variables in the correlation matrix correlate very highly with one another and singularity occurs when variables correlate perfectly with one another (Field et al., 2012). To avoid problems with multicollinearity, Tabachnick and Fidell (2007) recommended that the squared multiple correlations (SMC) of variables should not be greater than .90. The highest SMC value of the remaining 68 items was .82.

Bartlett's test of sphericity assesses whether the correlation matrix for a set of variables is an identity matrix, which means the variables are unrelated (Field et al., 2012). Bartlett's test was significant, $\chi^2(2278) = 18032.21$, $p < .001$, indicating that the correlation matrix was not an identity matrix, and the items were suitable for principal components analysis. The Kaiser-Meyer-Olkin test of sampling adequacy (KMO) assesses the size of the squared partial correlations between the variables relative to the size of the squared correlations (Field et al., 2012). The overall KMO value was .95 and the lowest KMO value for an individual item was .83. These values were well above the

minimal acceptable value of .50 (Field et al., 2012). Therefore principal components analysis was conducted on the remaining 68 items.

The number of items that were removed and the number that remained for each of the seven 'proposed' subscales is outlined in Table 4. Safety/Trust had the fewest remaining items (6 items).

Table 4

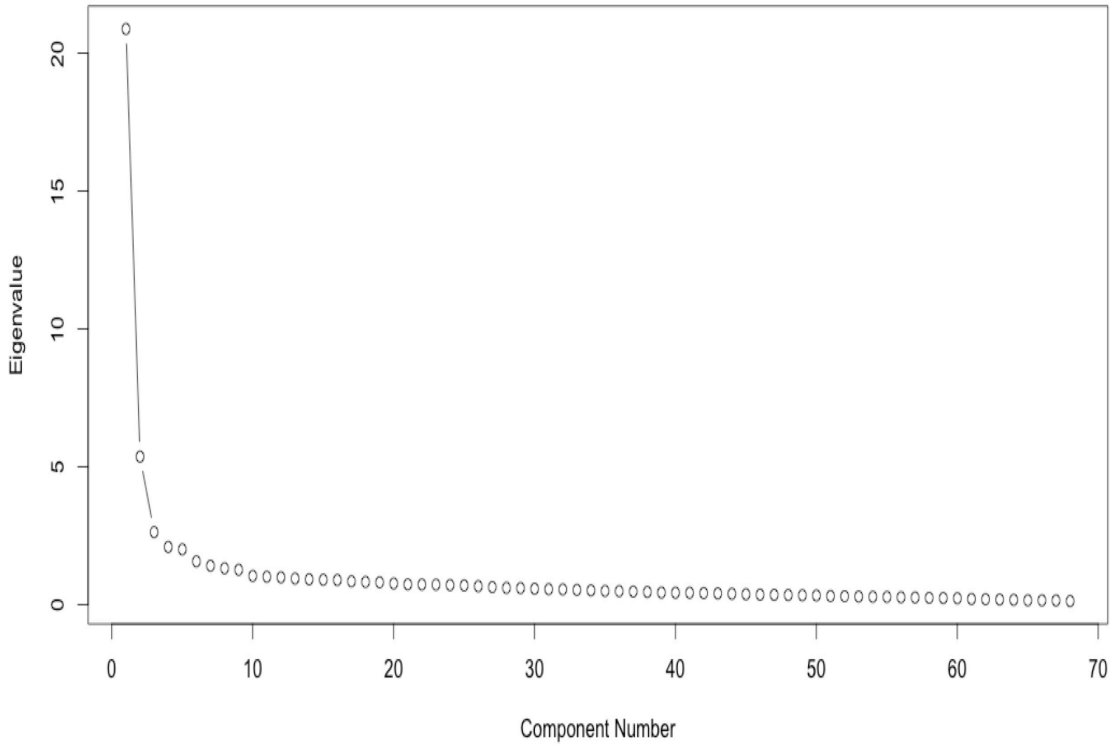
Items Removed and Items Remaining for the Seven 'Proposed' Subscales

'Proposed' Subscale	Initial Number of Items	Items Removed	Items Remaining
Authenticity/Natural	13	1	12
Coercion	10	3	7
Cheating/Fairness	11	1	10
Distributive Justice	11	4	7
Expected Benefits	19	3	16
Motivation	14	4	10
Safety/Trust	12	6	6

To determine the number of components to extract, the scree plot of the eigenvalues of the component loading matrix was examined and Horn's parallel analysis was conducted. Kaiser's criterion of extracting components with eigenvalues greater than 1 was not used as it is not considered reliable when there are more than 30 variables (Field et al., 2012). The scree plot of the eigenvalues from the principal components analysis conducted on the remaining 68 ATPCE Scale items is shown in Figure 2. From the scree plot it appeared that either three or four components should be extracted. Horn's parallel analysis involves creating random data sets that are the same size as the

Figure 2

Scree Plot from Principal Components Analysis of the 68 ATPCE Scale Items



data set of interest, finding the eigenvalues for the variables in each random data set, determining the mean or 95th percentile of the eigenvalues for each variable across the random data sets and then only extracting those components from the data set of interest that have an eigenvalue above the mean or 95th percentile of the eigenvalues from the random data sets (Zwick & Velicer, 1986). Horn's parallel analysis was conducted using the *paran* package (Version 1.5.1; Dinno, 2012) for R. The number of random data sets to generate was set at 1000 as generating at least 500 random data sets tends to provide more accurate results (Zwick & Velicer, 1986). The 95th percentile was used as it is less

likely to result in too many components being extracted (Zwick & Velicer, 1986). Horn's parallel analysis indicated that five components should be extracted.

Based on the scree plot and Horn's parallel analysis three, four and five component solutions were tried using oblimin (oblique) and promax (oblique) rotations. Oblique rotations were selected as it was expected that the components could be related. Hair et al. (1998) suggested that component loadings of .30 or above are significant when there are 350 participants. Matsunaga (2010) though indicated that .40 was the lowest acceptable level for loadings. Field et al. (2012) indicated that an item should only be retained if the communality is above .30. Based on these recommendations, items were only retained if the component loading was .40 or above, the communality was .30 or above and there was no double loading above .30. The five component solutions were rejected. There was a fifth component that was difficult to interpret with both the oblimin and promax rotations. The three component solutions were also rejected. Some items loaded on components they did not fit with conceptually. The four component solutions were more plausible. Both of these solutions had a Cheating/ Unfairness component, an Expected Benefits component, a Motivation component and a Safety component. The promax rotation provided the best solution as there were fewer conceptually ambiguous loadings on the four components and there was one additional Safety item retained.

Three runs of principal component analysis with promax rotation were conducted on the 68 ATPCE Scale items. With the first run, 24 items were removed that had component loadings below .40, double loadings above .30 and/or communalities below .30. With the second run, 2 more items were removed. With the third run, all of the remaining items met the criteria for being retained and no additional items were removed.

The component loadings and communalities of the remaining 42 items are presented in Table 5. This is based on the pattern matrix. The pattern matrix contains the loadings of each item on the components, in contrast to the structure matrix which contains the correlations between the items and the components (Field et al., 2012). The components Cheating/Unfairness, Expected Benefits, Motivation and Safety explained 52% of the total variance. The Cheating/Unfairness component had 19 items. Higher scores on this component indicated greater concern that it is cheating or unfair for healthy people to take cognitive enhancing drugs. The Motivation component had 10 items. Higher scores indicated higher motivation to use cognitive enhancing drugs. The Expected Benefits component had 9 items. Higher scores indicated greater expectations for the benefits of cognitive enhancing drugs. The Safety component had 4 items. Higher scores indicated greater concern about the safety of cognitive enhancing drugs.

Pearson's correlation coefficients and 95% CIs were calculated to assess the strength of the correlations between scores on each of the components. Scores on Cheating/Unfairness were moderately correlated with scores on Motivation ($r(463) = -.59$, $p < .001$ (95% CI: -.64, -.53)) and Expected Benefits ($r(463) = -.38$, $p < .001$ (95% CI: -.46, -.30)), and weakly correlated with scores on Safety ($r(463) = .29$, $p < .001$ (95% CI: .20, .37)). Participants who believed more strongly that it was cheating or unfair for healthy people to use cognitive enhancing drugs tended to be less motivated to use cognitive enhancing drugs, had lower expectations for the benefits of cognitive enhancing drugs and were more concerned about the safety of cognitive enhancing drugs. Scores on Motivation were moderately correlated with scores on Expected Benefits (($r(463) = .52$, $p < .001$ (95% CI: .45, .59)) and Safety (($r(463) = -.34$, $p < .001$ (95% CI: -.41, -.25)).

Table 5

Component Loadings and Communalities for the Principal Components Analysis With Promax Rotation of the Final 42 ATPCE Scale Items (N= 465)

Scale Item	Cheating/ Unfairness	Motivation	Expected Benefits	Safety	Communality
Students who use cognitive enhancing drugs should be punished.	**.84**	.04	.05	-.02	.63
People should tell their teacher if they know someone is taking a cognitive enhancing drug at school.	**.83**	.06	.10	.01	.59
People should take less credit for work done under the influence of a cognitive enhancing drug.	**.82**	.06	.03	.11	.67
People should tell their boss if they know someone is taking a cognitive enhancing drug at work.	**.81**	.24	.03	.03	.49
People who take cognitive enhancing drugs at work should be paid less.	**.77**	.16	.01	.00	.47
The use of cognitive enhancing drugs by healthy adults is a form of cheating.	**.73**	-.02	.09	-.05	.50
Parents should not allow their children to use cognitive enhancing drugs because it is a form of cheating.	**.71**	-.08	.04	.21	.69
Like steroid use in sports competitions, taking cognitive enhancing drugs in school is unfair.	**.71**	-.10	.11	.12	.61
Everyone should be allowed to use cognitive enhancing drugs, even those who are very smart.	**-.64**	.07	.20	.18	.57
It is the role of the government to discourage the use of cognitive enhancing drugs by healthy adults.	**.63**	.21	-.05	.27	.44
Healthy adults should not be allowed to use cognitive enhancing drugs because they do not need them to function.	**.62**	-.16	.05	-.04	.48
Everyone should be allowed to use cognitive enhancing drugs.	**-.60**	.13	.20	.17	.58
It is fair for healthy people to take a cognitive enhancing drug.	**-.60**	.18	.07	.16	.53

Scale Item	Cheating/ Unfairness	Motivation	Expected Benefits	Safety	Communality
People should be free to use whatever means they can to enhance their cognitive abilities.	**-.59**	.12	.16	.11	.53
The use of cognitive enhancing drugs will deprive people of opportunities to learn from their mistakes.	**.58**	-.10	.11	.17	.47
People can make their own decisions whether they want to use cognitive enhancing drugs.	**-.56**	-.09	.20	.26	.36
I would not think less of a friend if he or she started using a cognitive enhancing drug.	**-.51**	.14	.00	.09	.34
Access to cognitive enhancing drugs should be limited to those in need.	**.50**	-.03	.03	.09	.30
Taking a drug to enhance my cognitive abilities would change who I am as a person.	**.45**	- .20	.11	.03	.31
I would try a cognitive enhancing drug even if there were a risk of some moderate side effects.	.06	**.84**	-.10	-.05	.60
I would try a cognitive enhancing drug even if there were a risk of some mild side effects.	.02	**.83**	-.08	-.09	.67
I would take a cognitive enhancing drug if it were safe and effective.	-.01	**.82**	.09	.13	.72
I often think about taking a drug to enhance my cognitive abilities.	.05	**.79**	-.07	.05	.51
I would take a cognitive enhancing drug in order to do better at school or work.	-.09	**.77**	.14	.07	.79
I would take a cognitive enhancing drug if all of my friends took it.	.23	**.77**	.17	.10	.55
I would not take a cognitive enhancing drug, even if it were free.	.12	**-.70**	-.06	.04	.68
I would take a cognitive enhancing drug only when I really needed to. For example, to study, stay alert, to meet a deadline at work, or to focus	-.10	**.64**	.19	.03	.67
I would not take a cognitive enhancing drug even if others around me were taking it.	.13	**-.64**	.02	.03	.52
I would not take a cognitive enhancing drug because I do not need to.	-.01	**-.61**	.00	.22	.51

Scale Item	Cheating/ Unfairness	Motivation	Expected Benefits	Safety	Communality
Cognitive enhancing drugs will make people smarter.	.09	-.03	**.79**	-.02	.55
Cognitive enhancing drugs will help people to get good jobs.	.07	-.02	**.73**	-.07	.50
Cognitive enhancing drugs will allow us to perform tasks more quickly.	.08	.11	**.67**	.03	.49
Societies that encourage the use of cognitive enhancing drugs will be more innovative than societies that do not.	.10	.02	**.67**	-.18	.45
Cognitive enhancing drugs will improve our ability to remember.	-.11	-.09	**.67**	.03	.44
Cognitive enhancing drugs improve the quality of life.	-.09	-.02	**.64**	-.16	.50
Some people are naturally smarter than others. Cognitive enhancing drugs would help to reduce these natural differences.	.19	.01	**.62**	-.04	.34
In the future, cognitive enhancing drugs will improve the quality of people's lives.	-.11	.10	**.53**	-.14	.45
Cognitive enhancing drugs will help students do better in school.	-.07	.15	**.44**	.00	.33
There may be long-term risks and side effects of taking a cognitive enhancing drug.	-.05	.15	-.16	**.77**	.53
We do not know enough about the brain to safely develop cognitive enhancing drugs.	.15	.10	-.21	**.62**	.46
I would be concerned about the safety of taking a cognitive enhancing drug.	.06	-.21	.06	**.58**	.49
The fact that we never really know the long-term safety of drugs would persuade me from taking a cognitive enhancing drug.	.09	-.24	.06	**.43**	.35
% of Variance	21	15	10	5	
Cronbach's Alpha	.93	.93	.84	.63	

Participants with greater motivation to use cognitive enhancing drugs tended to have greater expectations for the benefits of cognitive enhancing drugs and were less concerned about safety. The correlation between scores on Expected Benefits and scores on Safety was not statistically significant ((*r*(463) = -.04, *p* > .05 (95% CI: -.13, .05)).

Cronbach's alpha was calculated for each of the four components. Internal consistency was high for the Cheating/Unfairness (α = .93; 95% CI: .92, .95), Motivation (α = .93; 95% CI: .90, .95) and Expected Benefits (α = .84; 95% CI: .80, .87) components. The internal consistency for the Safety component (α = .63; 95% CI: .54, .71) was moderate.

Initial Evidence of Construct Validity

Once the components of the ATPCE Scale were determined, a number of hypotheses were made to investigate the construct validity of the scale. In previous studies it has been found that nonmedical users were less likely than nonusers to think it is unacceptable or unfair for healthy people to use prescription drugs for cognitive enhancement (Franke et al., 2012; Ott & Biller-Andorno, 2014; Sümbül-Şekerci et al., 2021). It therefore was expected that users (had taken a prescription drug without a prescription or an over-the-counter drug for cognitive enhancement purposes) would be less concerned that it is cheating or unfair for healthy people to use prescription drugs for cognitive enhancement and would score statistically significantly lower on the Cheating/Unfairness subscale than nonusers (had not taken a prescription or over-the-counter drug for cognitive enhancement purposes).

Judson and Langdon (2009) found that nonmedical users of prescription stimulants tended to report more motives to use than nonusers. It has also been found

that nonmedical users of prescription drugs specifically for cognitive enhancement tend to report a greater willingness to use in the future than nonusers (Sattler et al., 2014; Sattler & Schunck, 2016; Wiegel et al., 2016). Given these findings it was expected that users would be more motivated to use cognitive enhancing drugs and would score statistically significantly higher on the Motivation subscale than nonusers.

Positive expectancies have been shown to be associated with nonmedical use of prescription stimulants among university students (Arria et al., 2018; Looby & Earlywine, 2010; Lookatch et al., 2012). Looby and Earlywine (2010) found that recreational users (use without a prescription) of prescription stimulants expected greater cognitive enhancing benefits than nonusers. Therefore, it was predicted that users would have higher expectations of the benefits of cognitive enhancing drugs and would score statistically significantly higher on the Expected Benefits subscale than nonusers.

In previous studies it has been found that nonmedical users of prescription drugs for cognitive enhancement tend to be less concerned about safety than nonusers (Eickenhorst et al., 2012; Gudmundsdottir et al., 2020; Nguyen et al., 2021; Ott & Biller-Andorno, 2014). It was expected that users would be less concerned about the safety of cognitive enhancing drugs and would score statistically significantly lower on the Safety subscale than nonusers.

Individuals who have more positive attitudes toward pharmacological cognitive enhancement may be willing to spend more money for cognitive enhancing drugs than individuals with more negative attitudes. It was expected that there would be statistically significant positive correlations between the amount participants were willing to spend per month on a safe and effective cognitive enhancing drug and their scores on the

Motivation and Expected Benefits subscales. Participants with higher motivation to use cognitive enhancing drugs and higher expectations about their effects were expected to be willing to spend more money. Statistically significant negative correlations were expected between the amount participants were willing to spend and their scores on the Cheating/Unfairness and Safety subscales. Participants who were less concerned about the morality and safety of using cognitive enhancing drugs were expected to be willing to spend more money.

Before performing the analyses normality was assessed for each variable by examining the histogram for the variable and the normal Q-Q plot. Boxplots were used to look for potentially influential outliers. For analyses that involved comparing group means, homogeneity of variance was assessed using the Brown-Forsythe test. For bivariate analyses scatterplots were examined to assess if there was evidence of a linear or monotonic relationship between the variables. As a number of comparisons were performed in this study, Bonferroni correction was applied to reduce the chances of Type 1 error. The p value was set to .004 (p = .05 / 12 comparisons = .004).

As there were so few nonmedical users (n = 22) in comparison to nonusers (n = 404), the user group (n = 44) included both the nonmedical users and the over-the counter users (n = 22). The medical users (n = 17) were excluded as they were taking prescription drugs for a diagnosed medical condition and not for cognitive enhancement purposes. As predicted, users (M = 3.04, SD = 1.15) showed less concern that it was cheating or unfair for healthy people to use cognitive enhancing drugs and scored statistically significantly lower on the Cheating/Unfairness component than nonusers (M = 4.30, SD = 1.12), $t(446) = -7.06$, $p < .001$, $d = -1.11$. Also as expected, users (M =

4.62, *SD* = 1.30) had higher motivation to use cognitive enhancing drugs and scored statistically significantly higher on the Motivation component than nonusers (*M* = 2.71, *SD* = 1.32), *t*(446) = 9.12, *p* < .001, *d* = 1.46. As predicted, users (*M* = 3.97, *SD* = .90) expected greater benefits from using cognitive enhancing drugs and scored statistically significantly higher on the Expected Benefits component than nonusers (*M* = 3.47, *SD* = .98), *t*(446) = 3.24, *p* = .001, *d* = 0.53. Also as expected, users (*M* = 4.96, *SD* = .89) showed less concern about the safety of cognitive enhancing drugs and scored statistically significantly lower on the Safety component than nonusers (*M* = 5.70, *SD* = .98), *t*(446) = -4.77, *p* < .001, *d* = -0.79. Group membership (users versus nonusers) had a large effect on the mean score for the Cheating/Unfairness and Motivation components and a medium effect on the mean score for the Expected Benefits and Safety components.

Also Spearman's rank correlation coefficients were calculated between each of the four components and how much the participants were willing to spend per month on a safe and effective cognitive enhancing drug. Confidence intervals were determined using bias-corrected and accelerated (BCA) bootstrapping (2000 samples were used) (DiCiccio, & Efron, 1996). As expected there were statistically signficant positive correlations between the amount participants were willing to spend per month and their scores on the Motivation component, r_s = .64, *p* < .001 (95% CI: .58, .69) and the Expected Benefits component, r_s = .42, *p* < .001 (95% CI: .34, .49). Also as expected there were statistically significant negative correlations between the amount participants were willing to spend per month and their scores on the Cheating/Unfairness component, r_s = -.37, *p* < .001 (95% CI: -.44, -.28) and the Safety component, r_s = -.27, *p* < .001 (95% CI: -.35, -.18) Participants who had higher motivation to use cognitive enhancing drugs and

expected greater benefits from using them tended to be willing to spend more money on a safe and effective cognitive enhancing drug. Participants who were less concerned that it was cheating or unfair for healthy people to use cognitive enhancing drugs and were less concerned about the safety of cognitive enhancing drugs also tended to be willing to spend more money.

The analysis was run again after removing the participants (n = 228) who indicated they were not interested in taking a drug to enhance their cognitive abilities. The magnitude of the correlations could be affected by the skewness in the data (i.e., the inclusion of many 0s). With these participants removed, the correlation between how much the participants were willing to spend and their scores on the Motivation component was reduced but still statistically significant, r_s = .23, p < .001 (95% CI: .10, .35). The correlation was no longer statistically significant for the Expected Benefits component, r_s = .18, p = .007 (95% CI: .04, .30), according to the corrected significance level of p = .004. The correlation between how much the participants were willing to spend and the Cheating/Unfairness component was no longer statistically significant, r_s = -.03, p > .05 (95% CI: -.16, .10). The correlation with the Safety component was also no longer statistically signficant, r_s = -.08, p > .05 (95% CI: -.20, .05).

Discussion

The primary purpose of Study 1 was to investigate the underlying structure of the ATPCE Scale and produce a smaller pool of items that could be used in later stages of the project. Although it was predicted that the scale would have seven components, or subscales, (Cheating/Fairness, Expected Benefits, Motivation, Authenticity/Natural, Distributive Justice, Coercion and Safety/Trust), the principal components analysis

revealed a four-component structure. Based on the content of the items that loaded on the four components, the components were labeled Cheating/Unfairness (19 items), Motivation (10 items), Expected Benefits (9 items) and Safety (4 items). The Cheating/Unfairness component assessed attitudes toward whether it is cheating or unfair for healthy adults to use cognitive enhancing drugs. The Motivation component assessed how motivated an individual is to use cognitive enhancing drugs. The Expected Benefits component assessed expectations about the benefits for individuals and society of using cognitive enhancing drugs. The Safety component assessed attitudes about the safety of using cognitive enhancing drugs. The 42-item revised ATPCE Scale explained 52% of the total variance.

Although it was predicted there would be an Authenticity/Natural component to the ATPCE Scale, no such component emerged from the principal components analysis. The 13 Authenticity/Natural items that were created for the scale dealt with a number of different issues including whether taking cognitive enhancing drugs would affect self-identity and the meaning of achievement, and whether it is unnatural to take such drugs. These issues may have been too disparate, resulting in inter-item correlations that were too small for an Authenticity/Natural component to emerge. Not all of the Authenticity/Natural items were removed. Five of the items loaded on the Cheating/Unfairness component (e.g., “People who take cognitive enhancing drugs at work should be paid less”) and one loaded on the Expected Benefits component (“Some people are naturally smarter than others. Cognitive enhancing drugs would help to reduce these natural differences”). In their review of 40 studies dealing with public attitudes toward cognitive enhancement, Schelle et al. (2014) discussed concerns about

the authenticity of work performed using cognitive enhancing drugs in terms of fairness. The Authenticity/Natural items that loaded on the Cheating/Unfairness component addressed concerns about unfairness to others (e.g., "People should take less credit for work done under the influence of a cognitive enhancing drug") and unfairness to oneself (e.g., "The use of cognitive enhancing drugs will deprive people of opportunities to learn from their mistakes").

There was also no Distributive Justice component found. Some of the 11 Distributive Justice items addressed who would have access to cognitive enhancing drugs in the future (e.g., "Wealthy people will have greater access to cognitive enhancing drugs"), while other items addressed who should have access (e.g., "Everyone should be allowed to use cognitive enhancing drugs, even those who are very smart"). Individuals' attitudes about who would have access may not necessarily correlate strongly with their attitudes about who should have access. Even those who believe that "everyone should be allowed to use cognitive enhancing drugs" may not necessarily agree that "schools should provide cognitive enhancing drugs to all students". It's also possible that the participants were not that concerned about distributive justice issues. Scheske and Schnall (2012) found that Cambridge University students tended not to be concerned about distributive justice issues, but they only considered the issue of an individual's wealth determining access. Not all of the Distributive Justice items were removed. Five items loaded on the Cheating/Unfairness component (e.g., "People should be free to use whatever means they can to enhance their cognitive abilities"). There were two themes running through these items. One was that everyone should be free to use cognitive enhancing drugs (e.g., "Everyone should be allowed to use cognitive enhancing drugs")

and the other was that access should be limited to those that actually need the drugs (e.g., "Healthy adults should not be allowed to use cognitive enhancing drugs because they do not need them to function"). Although most academics have conceptualized distributive justice issues as being separate from concerns about cheating, the fact that so many of the Distributive Justice items loaded on the Cheating/ Unfairness component indicates that the participants viewed them as being related. Both deal with questions of fairness.

No Coercion component emerged from the principal components analysis either. The 10 Coercion items dealt with both direct coercion (e.g., "People in certain careers should be required to use cognitive enhancing drugs. Some example careers include airline pilots, surgeons, etc") and indirect coercion (e.g., "The pressure of knowing others take cognitive enhancing drugs would make it hard to resist taking them"). Individuals' attitudes toward direct coercion may not necessarily correlate strongly with their attitudes toward indirect coercion. Also some items were written in first person (e.g., "I would take a cognitive enhancing drug if all of my friends took it"), while other items were written in third person (e.g., "In the future, parents might feel pressure to give their children cognitive enhancing drugs"). Individuals' attitudes about whether they would feel pressure to take cognitive enhancing drugs if others were using them may be quite different than their attitudes about whether other people would feel such pressure. For example, Hiltrop and Sattler (2022) found that many of the parents they interviewed were concerned that societal pressures for children to perform well academically could lead to some parents giving their children cognitive enhancing drugs, but none of them admitted such pressures would affect them. The participants also may not have been that concerned about coercion. Schools are not forcing healthy students to take cognitive

enhancing drugs, so there is no direct coercion. Indirect coercion may be minimal as 86.88% of the sample indicated they had never taken an over-the-counter or prescription drug for cognitive enhancement purposes. Not all of the Coercion items were removed. One item loaded on the Cheating/Unfairness component ("People can make their own decisions whether they want to use cognitive enhancing drugs") and two items loaded on the Motivation component (e.g., "I would not take a cognitive enhancing drug even if others around me were taking it"). Both of the Coercion items that loaded on the Motivation component were written in first person, as were all the other Motivation items.

There was evidence for the internal consistency of the revised ATPCE Scale. The Cronbach's alpha for the Cheating/Unfairness, Motivation, and Expected Benefits components were all greater than .80, indicating good internal consistency (Field et al., 2012). The Cronbach's alpha for the Safety component though was much lower (α = .63). The Safety component had only 4 items. Cronbach's alpha is affected by the number of items in a scale (Tavakol & Dennick, 2011). Having a smaller number of items in the Safety component may have reduced the value of the Cronbach's alpha.

Scores on the four components of the revised ATPCE Scale differentiated users (participants who had taken a prescription or over-the-counter drug during their lifetime for cognitive enhancement purposes) from nonusers (participants who had not taken a prescription or over-the-counter drug during their lifetime for cognitive enhancement purposes), providing some initial evidence for the construct validity of the scale. As expected, users scored statistically significantly higher on the Motivation and Expected Benefits components than nonusers, indicating greater motivation to use cognitive

enhancing drugs and greater expectations about the benefits of cognitive enhancing drugs. Also, as expected users scored statistically significantly lower on the Cheating/Unfairness and Safety components than nonusers, indicating less concern that it is cheating or unfair for healthy adults to use cognitive enhancing drugs and less concern about the safety of cognitive enhancing drugs. Group membership (user versus nonuser) had a large effect on the mean score for the Cheating/Unfairness and Motivation components and a medium effect on the mean score for the Expected Benefits and Safety components. These findings were consistent with previous research showing that nonmedical users tend to have greater motivation to use cognitive enhancing drugs (Judson & Langdon, 2009**;** Sattler et al., 2014; Sattler & Schunck, 2016; Wiegel et al., 2016), greater expectations about the benefits of cognitive enhancing drugs (Arria et al., 2018; Looby & Earlywine, 2010; Lookatch et al., 2012), fewer concerns about whether it is cheating or unfair for healthy people to use cognitive enhancing drugs (Franke et al., 2012; Ott & Biller-Andorno, 2014; Sümbül-Şekerci et al., 2021) and fewer concerns about the safety of cognitive enhancing drugs (Eickenhorst et al., 2012; Gudmundsdottir et al., 2020; Nguyen et al., 2021; Ott & Biller-Andorno, 2014).

The correlations between the participants' scores on the four components of the revised ATPCE Scale and the amount they were willing to spend per month on a safe and effective cognitive enhancing drug also provided some initial evidence for the construct validity of the scale. When all participants were included in the analyses all of the hypotheses were supported. Participants who scored higher on the Motivation and Expected Benefits components and lower on the Cheating/Unfairness and Safety components tended to be willing to spend more money each month for a safe and

effective cognitive enhancing drug. The correlation was large for the Motivation component, moderate for the Cheating/Unfairness and Expected Benefits components and small for the Safety component.

Study 2

The purpose of Study 2 was to provide additional evidence for the reliability of the four-component structure of the revised ATPCE Scale and for the validity of the scale. Participants completed the revised ATPCE Scale as well as other measures expected to be related to it. These other measures assessed ethical ideologies, attitudes toward doping in sports, perceived stress, satisfaction with current cognitive abilities and academic performance, and prescription drug expectancies. Confirmatory factor analysis was performed on the revised ATPCE Scale data to determine if there was support for the reliability of the four-component structure identified in Study 1 (Cheating/Unfairness, Motivation, Expected Benefits and Safety). The construct validity of the revised ATPCE Scale was assessed through correlational analyses between participants' scores on the four components of the ATPCE Scale and their scores on other measures and by comparing the mean component scores of users to nonusers. The hypotheses for these analyses are outlined below.

Cheating/Unfairness Subscale

Highly idealistic individuals believe that no action should be taken that could cause harm to other people (Forsyth, 1980). Etter et al. (2006) found that students who scored higher on idealism were significantly more likely to rate cheating with information technology as a serious offence. A number of possible harms from pharmacological cognitive enhancement have been identified (e.g., risk of coercion) (Greely et al., 2008;

Jwa, 2019; Metzinger & Hildt, 2011; Petersen, 2019). Therefore, it was predicted that there would be a statistically significant positive correlation between participants' scores on the Cheating/Unfairness subscale and their scores on the Idealism subscale of the Ethics Position Questionnaire (EPQ; Forsyth, 1980). Participants with higher idealism scores were expected to be more likely to judge nonmedical use of cognitive enhancing drugs as cheating or unfair.

There is some evidence that individuals may make similar moral judgements about the use of drugs for enhancement purposes, whether it is for cognitive enhancement or for performance enhancement in sports. In a community sample of Australian adults, Partridge et al. (2012) found that most participants judged both to be morally unacceptable. Participants that indicated it was acceptable for healthy adults to use cognitive enhancing drugs though were 9.5 times more likely to indicate that professional athletes should be able to use performance-enhancing drugs. Given this finding it was predicted that there would be a statistically significant negative correlation between participants' scores on the Cheating/Unfairness subscale and their scores on items from the Performance Enhancement Attitudes Scale (PEAS; Petróczi & Aidman, 2009) dealing with cheating and fairness (higher scores on the Cheating/Unfairness subscale indicates greater concern about cheating and unfairness, whereas lower scores on the PEAS items indicates greater concern). Participants who were less concerned about whether it cheating or unfair for healthy people to use cognitive enhancing drugs were also expected to be less concerned about whether it is cheating or unfair for athletes to use performance-enhancing drugs.

Two of the predictions in Study 1 about cheating and unfairness were also repeated in Study 2. It was expected that users would be less concerned that it is cheating or unfair for healthy people to use cognitive enhancing drugs and would score statistically significantly lower on the Cheating/Unfairness subscale than nonusers. Similarly, a statistically significant negative correlation was expected between participants' scores on the Cheating/Unfairness subscale and the amount they were willing to spend per month on a cognitive enhancing drug. Participants who were less concerned about the fairness of pharmacological cognitive enhancement were expected to be willing to spend more money.

Motivation Subscale

As higher levels of perceived stress have been reported in students (Liakoni et al., 2015; Sattler, 2019; Wolff & Brand, 2013) and adults in the workforce (Franke et al., 2013; Wiegel et al., 2016) who engage in nonmedical use for cognitive enhancement, it was expected that participants' scores on the Motivation subscale would be statistically significantly positively correlated with their scores on the Perceived Stress Scale (PSS-10; Cohen & Williamson, 1988). Participants who perceived their life as more stressful were expected to have higher motivation to use cognitive enhancing drugs.

As nonmedical users of prescription stimulants at university tend to be students who are struggling academically and have lower grades (Arria et al., 2013; Bavarian et al., 2013, 2014; Benson et al., 2015; Lucke et al., 2018), it was predicted that there would be a statistically significant negative correlation between participants' scores on the Motivation subscale and their ratings of their current cognitive abilities. Participants who rated their cognitive abilities lower were expected to have higher motivation to use

cognitive enhancing drugs. It was also predicted that participants' scores on the Motivation subscale would be statistically significantly negatively correlated with their satisfaction ratings for their current academic performance. Participants who were less satisfied with their performance were expected to have higher motivation to use cognitive enhancing drugs.

Nonmedical use of prescription stimulants in university students has been associated with self-reported problems with attention (Arria et al., 2011; Ilieva & Farah, 2019; Rabiner et al., 2009, 2010) and students often give the improvement of concentration or attention as a motive for nonmedical use (Benson et al., 2015; Sabbe et al., 2022; Smith & Farah, 2011). Therefore it was expected that participants' scores on the Motivation subscale would be statistically significantly negatively correlated with their satisfaction ratings for their current ability to pay attention. Participants who were less satisfied with their ability to pay attention were expected to have higher motivation to use cognitive enhancing drugs.

Another motive that university students often give for nonmedical use of prescription stimulants is to improve their memory (Castaldi et al., 2012; DeSantis et al., 2008; McDermott et al., 2021; Smith & Farah, 2011). Therefore it was predicted that participants' scores on the Motivation subscale would be statistically significantly negatively correlated with their satisfaction ratings for their current ability to remember. Participants who were less satisfied with their memory were expected to have higher motivation to use cognitive enhancing drugs.

Two of the predictions in Study 1 about motivation to use cognitive enhancing drugs were also repeated in Study 2. It was expected that users would be more motivated

to use cognitive enhancing drugs and would score statistically significantly higher on the Motivation subscale than nonusers. Similarly, participants' scores on the Motivation subscale were expected to be statistically significantly positively correlated with the amount they were willing to spend per month on a safe and effective cognitive enhancing drug. Participants who were more motivated to use cognitive enhancing drugs were expected to be willing to spend more money.

Expected Benefits Subscale

University students who engage in nonmedical use of prescription stimulants tend to have more positive expectancies about the drugs' effects than nonusers (Arria et al., 2018; Looby & Earlywine, 2010; Lookatch et al., 2012) and they also are more likely than nonusers to use alcohol and other drugs such as marijuana, cocaine, and prescription painkillers and tranquilizers (Arria et al., 2008; Benson et al., 2015; Kilmer et al., 2021; Sabbe et al., 2022). This raises the possibility that at least some individuals who are engaging in nonmedical use for cognitive enhancement may have positive expectancies about a variety of drugs. It was expected then that participants' scores on the Expected Benefits subscale would be statistically significantly positively correlated with their scores on the Positive/Instrumental Belief subscale of the Pharmacological Optimism Scale (POS; Kenna & Wood, 2008). Participants who had higher expectations about the effects of cognitive enhancing drugs were expected to have higher expectations about the effects of other prescription drugs.

It was also expected that participants' scores on the Expected Benefits subscale would be statistically significantly positively correlated with their scores on the Cognitive Enhancement subscale of the Prescription Stimulant Expectancy Questionnaire II

(PSEQII; Looby & Earlywine, 2010). Participants who had higher expectations about the effects of cognitive enhancing drugs were expected to have higher expectations about the cognitive enhancing effects of prescription stimulants.

Two of the predictions in Study 1 about the expected benefits of cognitive enhancing drugs were repeated in Study 2. It was predicted that users would have higher expectations of the benefits of cognitive enhancing drugs and would score statistically significantly higher on the Expected Benefits subscale than nonusers. Similarly, it was expected that there would be a statistically significant positive correlation between participants' scores on the Expected Benefits subscale and the amount of money they are willing to spend per month on a safe and effective cognitive enhancing drug. Participants who had higher expectations for the benefits of cognitive enhancing drugs were expected to be willing to spend more money.

Safety Subscale

When Partridge et al. (2014) interviewed Australian adults about their attitudes toward the use of drugs for cognitive enhancement and performance enhancement in sports, many of the participants expressed concern about the safety of using drugs for either type of enhancement. It was predicted then that participants' scores on the Safety subscale would be statistically significantly negatively correlated with their scores on items of the PEAS (Petróczi, & Aidman, 2009) dealing with drug safety (higher scores on the Safety subscale indicates greater concern about the safety, whereas lower scores on the PEAS items indicates greater concern). Participants who were more concerned about the safety of cognitive enhancing drugs were expected to be more concerned about the safety of performance-enhancing drugs in sports.

It was expected that participants' scores on the Safety subscale would be statistically significantly positively correlated with their scores on the Side Effects subscale of the POS (Kenna & Wood, 2008). Participants who were more concerned about the safety of cognitive enhancing drugs were expected to be more concerned about the safety of other prescription drugs.

Two of the predictions in Study 1 about the safety of cognitive enhancing drugs were repeated in Study 2. It was predicted that users would be less concerned about the safety of cognitive enhancing drugs and would score statistically significantly lower on the Safety subscale than nonusers. Additionally, it was expected that there would be a statistically significant negative correlation between participants' scores on the Safety subscale and the amount of money they were willing to spend per month on a safe and effective cognitive enhancing drug. Participants who were less concerned with the safety of cognitive enhancing drugs were expected to be willing to spend more money.

Method

Participants

Participants were recruited from first-year introductory psychology courses and second-year research methods and statistics in psychology courses at Trent University using the SONA participant management system. Students who had participated in Study 1 were ineligible. A total of 694 undergraduate students participated in the study. After screening for inappropriate responding, data from 92 participants (13.26%) were excluded from further analyses. An additional 22 participants' data (3.17%) were excluded because there were no data provided for the ATPCE Scale items. The final sample consisted of 580 participants (83.57%). Demographic information for the final

sample is provided in the Results. The Research Ethics Board of Trent University approved this study. Participating students were compensated with a 1.0 bonus course credit. Students who chose not to participate in psychology research projects were given the option to complete a written report for bonus course credit.

Measures

Demographics Questionnaire. This questionnaire was a revised version of part 1 of the ATPCE Scale questionnaire from Study 1 (see below for details). As before participants were asked to provide demographic information (age, gender, university year, current living arrangement, employment status, household income level, and ethnicity) (Appendix D). Participants were then asked to rate their current cognitive abilities (e.g., memory, attention/concentration, problem solving) on a 5-point Likert scale (Well below average to Well above average). They were also asked to indicate how satisfied they were with their current ability to pay attention, their current ability to remember, and their current academic performance on 7-point Likert scales (Very dissatisfied to Very satisfied). To more easily distinguish between using prescription versus over-the-counter drugs for cognitive enhancement purposes, a separate set of questions was created for each drug type. Participants were first asked if they had ever used a prescription drug to enhance their cognitive functioning. If "Yes" was selected, they were asked to list the drug and provide data about past year use, frequency of use, where the drug was obtained, the drug's effectiveness, and if any unpleasant side effects were experienced. The same series of questions were then asked about over-the-counter drugs. Participants could list and provide information for up to five drugs of each type.

Revised Attitudes Toward Pharmacological Cognitive Enhancement Scale (ATPCE). This questionnaire included the 42-item revised ATPCE Scale identified through the principal components analysis in Study 1 (Appendix E). The revised scale had 4 subscales. The Cheating/Unfairness subscale (19 items) assessed attitudes toward whether it is cheating or unfair for healthy people to use cognitive enhancing drugs. Higher scores indicated greater concern that is cheating or unfair to use such drugs. The Motivation subscale (10 items) assessed how motivated an individual is to take cognitive enhancing drugs. Higher scores indicated greater motivation to use cognitive enhancing drugs. The Expected Benefits subscale (9 items) assessed attitudes toward expected benefits from using cognitive enhancing drugs. Higher scores indicated higher expectations of the benefits to be gained from cognitive enhancing drugs. The Safety subscale assessed attitudes toward the safety of cognitive enhancing drugs (4 items). Higher scores indicated greater concern about the safety of cognitive enhancing drugs. Two additional items tested for inappropriate responding (strike questions). Participants were asked to indicate on a 7-point Likert scale how strongly they agreed or disagreed with each statement (Strongly Disagree to Strongly Agree). In addition to the scale items, participants were asked to list the benefits they would expect to gain if a safe and effective drug was available to enhance their cognitive abilities and to indicate how much they would be willing to pay for such a drug at increments of $10-per-month ($0 to $100 or more).

Performance Enhancement Attitudes Scale (PEAS). The PEAS measures attitudes toward doping in sports (Petróczi, & Aidman, 2009). The 17 items are assessed on a 6-point Likert scale (Strongly Disagree to Strongly Agree) with higher scores

indicating a more positive attitude toward using performance-enhancing drugs. Petróczi and Aidman (2009) provided evidence for the validity, internal consistency and test-retest reliability of the scale. Cronbach's alpha for the PEAS in this study was .84 (95% CI: .82, .87).

Pharmacological Optimism Scale (POS). Developed by Kenna and Wood (2008), the 37-item POS measures an individual's expectations about the effects of prescription drugs (stimulants, tranquilizers, painkillers). Items are assessed on a 5-point Likert scale (Strongly Disagree to Strongly Agree) and it has four subscales: Instrumental/Positive Beliefs (21 items), Side Effects (9 items), Euphoric Beliefs (5 items) and Protective Beliefs (2 items). For the purposes of this study only the Instrumental/Positive Beliefs subscale and the Side Effects subscale were of interest. Higher scores on the Instrumental/Positive Beliefs subscale indicate more positive expectations about the effects of prescription drugs. Higher scores on the Side Effects subscale indicate greater concern for possible side effects and the safety of taking prescription drugs. Some preliminary support for the internal consistency and validity of the POS has been shown (Kenna & Wood, 2008). Cronbach's alpha was .96 (95% CI: .95, .97) for the Instrumental/Positive Beliefs subscale and .88 (95% CI: .85, .91) for the Side Effects subscale in this study.

Prescription Stimulant Expectancy Questionnaire (PSEQII). The 45-item PSEQII measures an individual's beliefs about the effects of prescription stimulants (Looby & Earlywine, 2010). Looby and Earlywine (2010) asked their participants to indicate to what extent they would expect to experience each effect on a 3-point Likert scale (Not at all to Always). This was changed to a 5-point Likert scale (Not at all to

Always) to allow for a greater range of responses. The PSEQII has four subscales: Cognitive Enhancement (20 items), Arousal and Anxiety (11 items), Social Enhancement (9 items), and Guilt and Dependence (5 items). For the purposes of this study only the Cognitive Enhancement subscale was of interest. Higher scores on the Cognitive Enhancement subscale indicate higher expectations for prescription stimulants improving concentration, memory, and work enjoyment. There is evidence for the internal consistency and convergent validity of the questionnaire (Holt & Looby, 2018; Looby & Earlywine, 2010). In this study Cronbach's alpha for the Cognitive Enhancement subscale was .96 (95% CI: .95, .97).

Perceived Stress Scale (PSS-10). Developed by Cohen and Williamson (1988), the PSS-10 is a 10-item scale that measures the extent to which an individual perceives situations in their life as stressful. Participants are asked to indicate how often in the past month they have felt or thought certain things on a 5-point Likert scale (Never to Very Often). Higher scores indicate higher levels of perceived stress. The scale has been shown to have adequate internal consistency and construct validity (Cohen & Williamson, 1988; Roberti, Harrington & Storch, 2006). In this study Cronbach's alpha for the PSS-10 was .90 (95% CI: .87, .92).

Ethics Position Questionnaire (EPQ). The 20-item EPQ consists of two scales that assess an individual's approach to making moral judgments (Forsyth, 1980). The Idealism subscale (10 items) measures the extent to which an individual believes that harm to others can always be avoided if the right action is taken. The Relativism subscale (10 items) measures the extent to which an individual believes that there are no moral absolutes and what is moral depends on the person or situation. Four different

approaches to making moral judgments are categorized based on scores on the two subscales: Situationists (High Idealism, High Relativism), Subjectivists (Low Idealism, High Relativism), Absolutists (High Idealism, Low Relativism), and Exceptionists (Low Idealism, Low Relativism). For the purposes of this study only the Idealism subscale was of interest. Forsyth (1980) provided evidence for the internal consistency, test-retest reliability and validity of the scale. Cronbach's alpha for the Idealism subscale was .82 (95% CI: .79, .85) in this study.

The Balanced Inventory of Desirable Responding (BIDR). This was the same questionnaire as described in Study 1. Data from this measure were not analyzed as part of this thesis.

Procedure

The SONA participant management system was used to notify students of the opportunity to participate in the study. A brief description of the study was provided and potential participants were advised it would take approximately 60 minutes to complete the study online (Appendix F). If they were interested in participating, individuals clicked on the link provided and were taken to the Qualtrics Survey System website to complete a consent form (Appendix G). Those who clicked *Agree* on the consent form had an opportunity to complete the eight questionnaires. Participants always completed the Demographics questionnaire first. In order to minimize order effects the revised ATPCE Scale, the PEAS, the POS, the PSEQII, the PSS-10, and the EPQ were completed in one of six possible orders (Appendix H). Participants were assigned to one of the six orders based on the last two digits of their student number. For example, participants with student numbers ending in 00 to 16 completed the questionnaires in the

following order: ATPCE, PEAS, PSEQII, EPQ, PSS-10 and POS. All participants completed the BIDR last. After completing all of the questionnaires, or they had withdrawn, the participant was provided with a debriefing form to explain the purpose of the study and to provide contact information for the researchers and for counselling services, if needed (Appendix I)

Data Analysis

All data analyses were performed in R (Version 4.2.2; R Core Team, 2022). The revised ATPCE Scale data was assessed for univariate and multivariate normality. The histogram and normal Q-Q plot for each of the 42 items were examined to assess univariate normality. Multivariate normality was assessed by examining the chi-square Q-Q plot and conducting Mardia's multivariate skewness and kurtosis tests and the Henze-Zirkler test using the *MVN* package (Version 5.9; Korkmaz et al., 2014). Two confirmatory factor analyses were conducted on the 42-item revised ATPCE Scale using the *lavaan* package (Version 0.6-15; Rosseel, 2012). One analysis was run using the maximum likelihood with robust standard errors estimator (MLR) and the other with the weighted least squares means and variances adjusted estimator (WLSMV) and the results were compared. To determine goodness of fit several fit indices were evaluated including Chi-Square Goodness of Fit, the Standardized Root Mean Squared Residual (SRMR), the Root Mean Square Error of Approximation (RMSEA), the Comparative Fit Index (CFI) and the Tucker-Lewis Index (TLI). Cronbach's alpha statistics were calculated for each of the ATPCE subscales to assess internal consistency with a different sample.

For the construct validity analyses, normality was assessed for each of the

variables by examining the histogram for the variable and the normal Q-Q plot. Boxplots were used to look for potentially influential outliers. For analyses that involved comparing the means of two groups, homogeneity of variance was assessed using the Brown–Forsythe test. For bivariate analyses scatterplots were examined to assess if there was evidence of a linear or monotonic relationship between the variables. The mean score of users (had taken a prescription drug without a prescription or an over-the-counter drug for cognitive enhancement purposes during their lifetime) was compared to nonusers (had not taken a prescription or over-the-counter drug for cognitive enhancement purposes during their lifetime) on each of the subscales using *t*-tests. Two-tailed t-tests were used. Cohen's *d* was used to measure effect size. A series of correlational analyses were conducted to investigate the relationships between the participants' scores on each of the subscales and their scores on the other measures they were expected to be related to. For analyses that involved Spearman's rank correlation coefficients, confidence intervals were determined using bias-corrected and accelerated (BCA) bootstrapping (2000 samples were used).

Results

Demographics of the Sample

Demographic information for the 580 participants is provided in Table 6. The participants ranged in age from 17 to 61 years ($M = 20.36$, $SD = 4.59$) and most were female ($n = 536$, 92.57%), white ($n = 472$, 81.52%) and in their first ($n = 286$, 49.31%) or second year ($n = 204$, 35.17%) of university. The majority were living off-campus with roommates ($n = 192$, 33.10%) or their family ($n = 160$, 27.59%). Participants living on-campus made up 28.97% ($n = 168$) of the sample. Most of the participants were not

Table 6

Demographic Characteristics of Sample Study 2 (*N* = 580)

Characteristic	*M* (*SD*)	*n*	%
Age	20.36(4.59)	579	
Gender (*n* = 579)			
Male		43	7.43
Female		536	92.57
Year of university			
1st year		286	49.31
2nd year		204	35.17
3rd year		54	9.31
4th year		22	3.79
5th year and beyond		14	2.41
Currently living			
At home with your family		160	27.59
On campus		168	28.97
Away from home with roommate(s)		192	33.10
Away from home with romantic partner		34	5.86
Away from home on your own		26	4.48
Current employment status			
Working full-time		46	7.93
Working part-time		184	31.72
Not working		350	60.34
Household income level (*n* = 573)			
Under $10,000		128	22.34
$10,000 to 19,000		45	7.85
$20,000 to 29,000		29	5.06
$30,000 to 39,000		32	5.58
$40,000 to 49,000		30	5.24
$50,000 to 59,000		36	6.28
$60,000 to 69,000		34	5.93
$70,000 to 79,000		42	7.33
$80,000 to 89,000		38	6.63
$90,000 to 99,000		39	6.81
Over $100,000		120	20.94
Ethnicity (*n* = 579)			
Caucasian/White		472	81.52
Indigenous/First Nations		7	1.21
African/Black		25	4.32
Asian/Pacific Islander		34	5.87
Hispanic/Latino		4	.69
Other		37	6.39

Note. Percentages may not add up to 100% due to rounding.

currently employed (*n* = 350, 60.34%) or were only employed part-time (*n* = 184, 31.72%). As in Study 1, reported household income varied with the two largest groups of participants representing the highest and lowest income levels. Participants with a reported household income under $10,000 a year comprised 22.34% (*n* = 128) of the sample, while those with a household income exceeding $100,000 made up 20.94% (*n* = 120). As many of the participants were living at home with their family, some participants may have reported their parents' income rather than their own personal income.

Drug Use to Improve Cognitive Functioning

Of the 580 participants, only 72 participants (12.41%) indicated they had ever taken a prescription or over-the-counter drug to try and improve their cognitive functioning. Three participants (.52%) reported having taken both prescription and over-the-counter drugs for that purpose. Information on the participants' use of prescription and over-the-counter drugs is provided in Table 7. Only 2 participants listed multiple drugs at one time and in both cases the drugs listed were of one type (prescription or over-the-counter), therefore it was possible to analyze prescription drug use separately from over-the-counter drug use.

Prescription Drug Use. Only 49 of the 580 participants (8.45%) indicated they had ever used a prescription drug to try and improve their cognitive functioning. Although not included in Table 7, the most commonly reported prescription drugs used were Adderall (*n* = 20, 40.82% of prescription drug users), Ritalin (*n* = 10, 20.41% of prescription drug users), Concerta (*n* = 6, 12.24% of prescription drug users) and Vyvanse (*n* = 6, 12.24% of prescription drug users). Ritalin and Concerta are trade

Table 7

Characteristics of Drug Use to Improve Cognitive Functioning Study 2 (N = 580)

Characteristic	Prescription Drugs (n = 49)		Over-the Counter Drugs (n = 26)	
	n	%	*n*	%
Lifetime use				
Yes	49	8.45	26	4.48
No	531	91.55	554	95.52
Past year use				
Yes	37	6.38	13	2.24
No	543	93.62	567	97.76
Frequency of use if used in the past year				
Daily	18	48.65	4	30.77
Weekly			3	23.08
Once a month	3	8.11	1	7.69
Less than once a month	16	43.24	5	38.46
Drug effective in enhancing cognition				
Yes	40	81.63	8	30.77
No	9	18.37	18	69.23
Experienced unpleasant side effects				
Yes	23	46.94	4	15.38
No	26	53.06	22	84.62
Source of drug				
A doctor prescribed it to me	24	48.98		
A friend	22	44.90	2	7.69
A pharmacy	4	8.16	9	34.62
A health food store			10	38.46
Parent gave it to me			3	11.54
Took from a family prescription	1	2.04		
The internet			1	3.85
Other	1	2.04	2	7.69

Note. Percentages for Source of drug add up to more than 100% because participants could list multiple drugs and multiple sources for each drug.

names for methylphenidate and Adderall is a trade name for a mixture of amphetamine and dextroamphetamine. Vyvanse is a trade name for lisdexamfetamine, which the

digestive system breaks down into dextroamphetamine. All of these drugs are used in the treatment of ADHD. Although often discussed in the academic literature on nonmedical use of prescription drugs for cognitive enhancement, only 2 participants (4.08% of prescription drug users) indicated they had used modafinil. As in Study 1, a few participants listed drugs that were unexpected (e.g. the antibiotic cephalexin; marijauna which was legal only with a prescription at the time the study was conducted).

Of the 580 participants, 37 (6.38%) had taken at least one prescription drug in the past year to try and improve their cognition. The past year users tended to use either daily (n = 18, 48.65% of past year users) or less than once a month (n = 16, 43.24% of past year users). The majority of the prescription drug users (n = 40, 81.63%) indicated that at least one of the prescription drugs they had taken had been effective in improving their cognition. Unpleasant side effects had been experienced by 23 (46.94%) of the prescription drug users. The most commonly reported side effects included headaches, anxiety/nervousness, insomnia/sleep disturbance, gastrointestinal problems, loss of appetite, dizziness, increased heart rate, restlessness, and depression.

Prescription drugs were obtained from a variety of sources. Twenty-four participants (48.98% of prescription drug users) indicated the prescription drug(s) they had taken had been prescribed by a doctor. Most of the other prescription drug users (n = 22, 44.90%) indicated they had obtained the drug(s) from friends. One participant (2.04% of prescription drug users) reported taking a drug from a family member's prescription.

Over-the-Counter Drug Use. Of the 580 participants, 26 (4.48%) indicated they had taken an over-the-counter drug during their lifetime to try and improve their

cognitive functioning. Although not included in Table 7, the most commonly reported over-the-counter drugs used were Gingko biloba (*n* = 13, 50.00% of over-the-counter drug users) and ginseng (*n* = 10, 38.46% of over-the-counter drug users). Two of the participants who had taken ginseng specified Siberian ginseng. Siberian ginseng (scientific name *Eleutherococcus senticosus*) has different active ingredients than American (scientific name *Panax quinquefolius*) or Asian (scientific name *Panax ginseng*) ginseng.

Of the 580 participants, 13 (2.24%) had taken at least one over-the-counter drug in the past year to try and improve their cognition. Frequency of use varied among the past year users of over-the-counter drugs. The most frequent use was daily for 4 participants (30.77% of past year users), weekly for 3 participants (23.08% of past year users), monthly for 1 participant (7.69% of past year users) and less than once a month for 5 participants (38.46% of past year users). Unlike the majority of the prescription drug users, the majority of the over-the-counter drug users (*n* = 18, 69.23%) indicated that the drug(s) they had taken had not been effective in improving their cognitive functioning. Unpleasant side effects had been experienced by only 4 (15.38%) of the over-the-counter drug users. Reported side effects included headaches, abdominal pain, nausea and gastrointestinal problems. Most of the over-the-counter drug users obtained the drugs from pharmacies (*n* = 9, 34.62%) or healthfood stores (*n* = 10, 38.46%). Three participants (11.54% of over-the counter drug users) had been given the drug by a parent.

User Groups. Based on the sources from which prescription drugs were obtained, 25 of the 580 participants (4.31%) were nonmedical users. Each of these participants had reported taking at least one prescription drug without a prescription to

improve their cognitive functioning. Twenty-four participants (4.14%) were medical users. These participants had reported a prescription for all of the prescription drugs they had taken to improve their cognitive functioning. Three of the 26 participants who had taken an over-the-counter drug to improve their cognitive functioning had also taken a prescription drug and were categorized based on their prescription drug use. The other 23 participants (3.97%) were categorized as over-the-counter users as they had only taken over-the-counter drugs to improve their cognitive functioning. The remaining participants (n = 508, 87.59%) were nonusers.

Expected Benefits from a Safe and Effective Cognitive Enhancing Drug

As in Study 1, the participants were asked to describe the benefits they would expect to gain if there were a safe and effective drug that could enhance their cognitive functioning. A response to this question was provided by 563 of the 580 participants. The benefits expected by most of the participants were similar to what had been mentioned by participants in Study 1 including greater ability to focus and concentrate, improved memory, greater productivity, better problem solving skills, greater motivation, increased alertness/wakefulness, better grades, faster processing of information, increased creativity, more free time and less stress. Three participants indicated they would expect to have more positive moods. This had not been mentioned as an expected benefit by any of the participants in Study 1. Twenty-two participants (3.91% of respondents) did not expect any benefit. Twenty-seven participants (4.80% of respondents) indicated they would not take a cognitive enhancing drug or expressed reservations about taking it. Some of these participants indicated they did not need a cognitive enhancing drug while other raised concerns about safety (possible side effects, risk of dependence/addiction),

that it would be cheating, that it would be unnatural to take it, and that any accomplishments would not be their own.

Motivation to Use a Safe and Effective Cognitive Enhancing Drug

Participants were asked how much money they would be willing to spend per month for a safe and effective cognitive enhancing drug. The results are presented in Table 8. As in Study 1, nearly half the participants (n = 274, 47.24%) indicated they were not interested in taking a drug to enhance their cognitive abilities. These participants had low motivation to use cognitive enhancing drugs. Most of the remaining participants (n = 277, 47.76%) were willing to spend less than $60 a month. Only 14 participants (2.41%) indicated they would be willing to spend $100 or more a month.

Table 8

Amount Willing to Spend per Month for a Safe and Effective Cognitive Enhancing Drug (N = 580)

Option	*n*	%
I am not interested in taking a drug to enhance my cognitive abilities.	274	47.24
$0 to $9	54	9.31
$10 to $19	73	12.59
$20 to $29	58	10.00
$30 to $39	42	7.24
$40 to $49	33	5.69
$50 to $59	17	2.93
$60 to $69	8	1.38
$70 to $79	2	.34
$80 to $89	2	.34
$90 to $99	3	.52
$100 or more	14	2.41

Confirmatory Factor Analysis

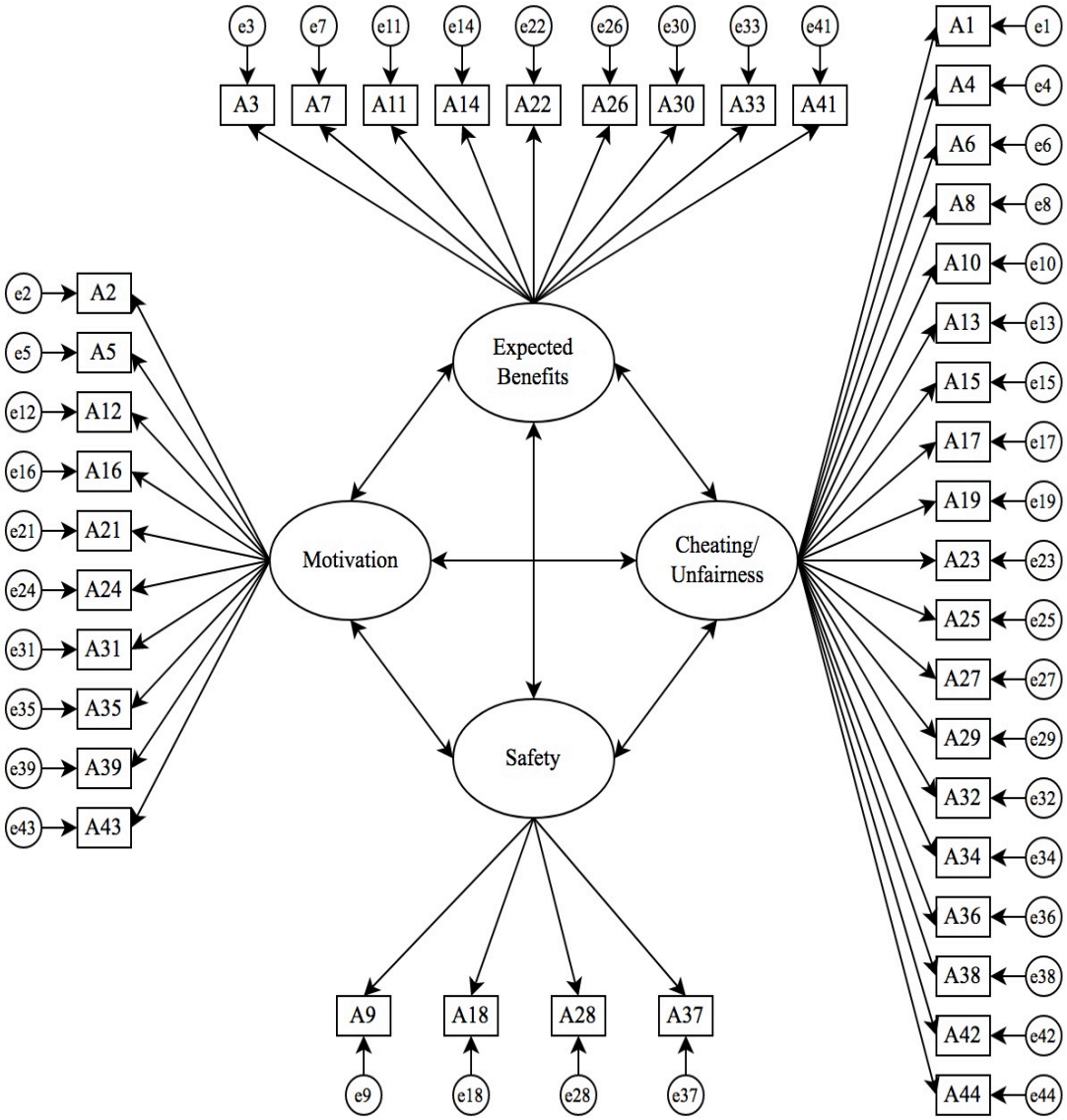
Confirmatory factor analysis was conducted to assess how well the four-component structure of the revised ATPCE Scale fit the data from an independent sample. If the hypothesized model based on the principal components analysis from Study 1 fit the data well then it would provide evidence for the reliability of the four-component structure of the scale. The hypothesized model is outlined in Figure 3. It included 4 factors based on the 4 components previously identified: Cheating/Unfairness (19 items), Motivation (10 items), Expected Benefits (9 items), and Safety (4 items). Items 20 and 40 were not included in the model as they were strike questions designed to test for inappropriate responding and were not part of the scale.

A total of .02% of the revised ATPCE Scale data points were missing. Four of the 580 participants had each missed 1 of the 42 scale items (2.38% of scale). The data appeared to be missing at random and in each case was replaced with the item mean.

The revised ATPCE Scale data were examined for normality. An examination of the histograms for the 42 scale items revealed that some of the items were positively or negatively skewed. The most extreme values were -1.22 for skewness and -1.37 for kurtosis. Curran et al. (1996) found that univariate non-normality became a significant problem in confirmatory factor analysis when skewness values were less than or equal to -2 or greater than or equal to 2 and kurtosis values were less than or equal to -7 or greater than or equal to 7. As none of the skewness or kurtosis values were that extreme, the scale items were not modified. Multivariate normality was assessed by examining the chi-square Q-Q plot and conducting Mardia's multivariate skewness and kurtosis tests and the Henze-Zirkler test. The chi-square Q-Q plot suggested some deviation from

Figure 3

Model 1 of the Attitudes Toward Pharmacological Cognitive Enhancement Scale



normality. All three multivariate tests of normality were significant ($p < .001$), indicating that the data might not be multivariate normal.

The data were also examined for multicollinearity and singularity. To avoid problems with multicollinearity, Tabachnick and Fidell (2007) recommended that the squared multiple correlations (SMC) of variables should not be greater than .90. The highest SMC value of the 42 items was .80, indicating there was not a problem with multicollinearity or singularity.

Maximum likelihood is the estimator most commonly used by researchers when conducting confirmatory factor analysis, but it assumes that the variables entered into the analysis are continuous and have a multivariate normal distribution (Finch & French, 2015; Li, 2016). As there was evidence that the data might not be multivariate normal, other methods for estimating model parameters were considered. The maximum likelihood with robust standard errors estimator (MLR) adjusts the chi-square test statistics and standard errors to reduce bias when data have a nonnormal distribution (Li, 2016). Although data derived from Likert-type scales is ordinal rather than continuous, researchers have indicated that the MLR estimator can be used if the scale items have 5 or more possible responses (Li, 2016). The revised ATPCE Scale items given to the participants had 7 possible responses (Strongly Agree to Strongly Disagree). Weighted least squares means and variances adjusted (WLSMV) is the diagonally weighted least squares estimator (DWLS) but with robust chi-square test statistics and standard errors (Li, 2016). It was developed for ordinal data and it does not require the observed variables to have a multivariate normal distribution (Li, 2016). In a Monte Carlo simulation study Li (2016) found that the WLSMV and MLR estimators had their own advantages and disadvantages with the WLSMV estimator providing more accurate factor loadings across different conditions, but the MLR estimator providing more

accurate standard error estimates. In situations where there were six or more possible responses per item, Finney et al. (2016) suggested analyzing data with a robust maximum likelihood estimator and a robust weighted least squares estimator and comparing the results. It was therefore decided that separate confirmatory factor analyses would be performed using the MLR and WLSMV estimators.

Confirmatory factor analyses were conducted using the *Lavaan* package (Version 0.6-15; Rosseel, 2012) in R. A number of indices were used to assess goodness of fit including the Chi-Square Goodness of Fit, the Standardized Root Mean Squared Residual (SRMR), the Root Mean Square Error of Approximation (RMSEA), the Comparative Fit Index (CFI) and the Tucker-Lewis Index (TLI). The Chi-Square Goodness of Fit test is an absolute fit index which assesses the extent to which the covariance matrix derived from the data differs from the hypothesized covariance matrix (Hu & Bentler, 1999). A problem with the Chi-Square Goodness of Fit test is that it is affected by sample size and with large samples the test is usually statistically significant (Bentler & Bonett, 1980). The SRMR is an absolute fit index derived from the residuals and it assesses the average difference between the observed correlations from the sample and the predicted correlations from the model (Brown, 2006). An SRMR value of 0 indicates perfect fit and a value of .08 or less is considered a good fit (Hu & Bentler, 1999). The RMSEA assesses the extent to which the hypothesized model differs from a perfect model (Tabachnick & Fidell, 2019). An RMSEA value of 0 indicates perfect fit and a value of .06 or less is considered a good fit (Hu & Bentler, 1999). The CFI and TLI are incremental fit indices that compare the fit of the hypothesized model to that of a baseline model with no relationships between the variables (Hu & Bentler, 1999). Hu and Bentler

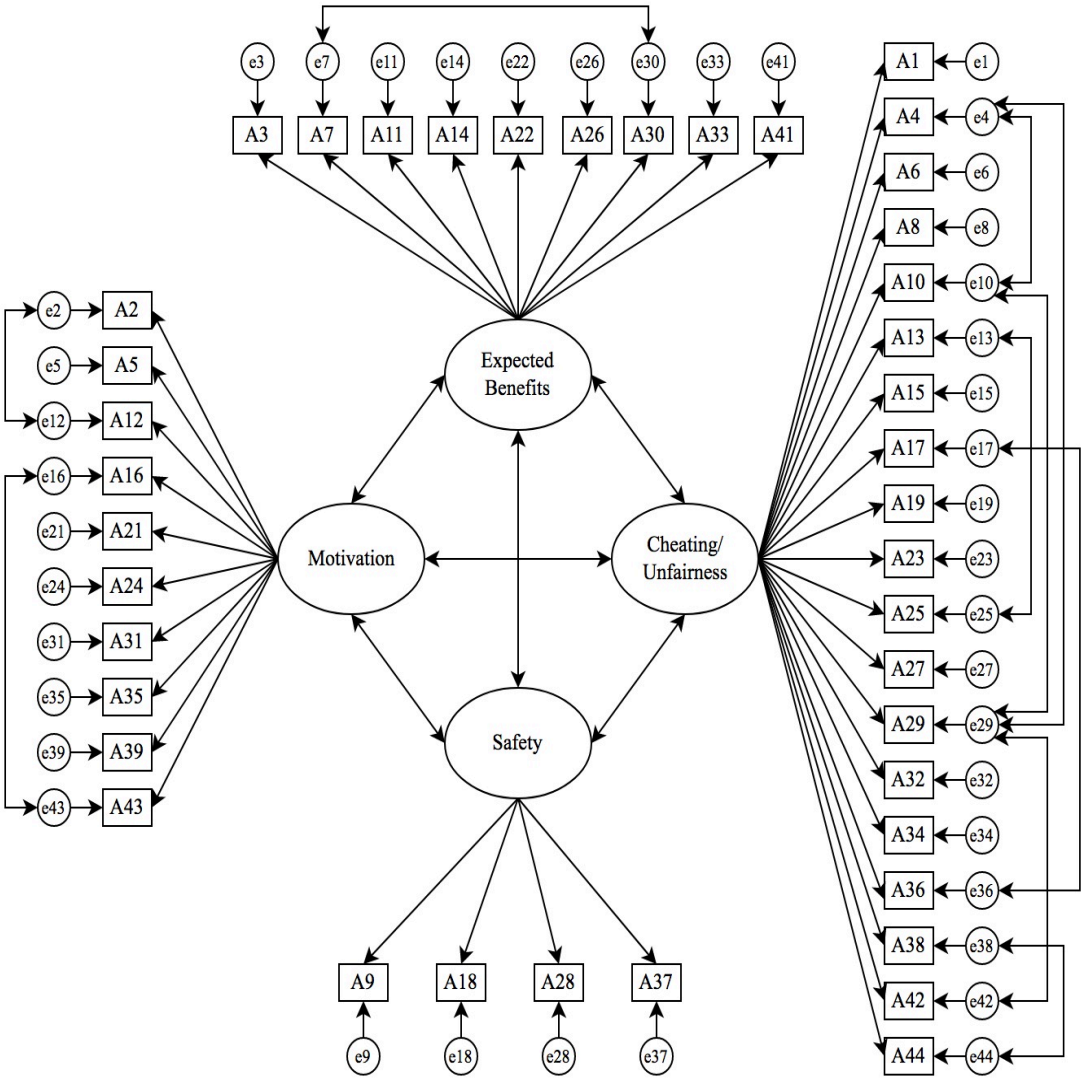
(1999) suggested CFI and TLI values of .95 or greater are indicative of good fit. A CFI or TLI value between .90 and .95 may indicate adequate fit (Brown, 2006).

A confirmatory factor analysis was run using the MLR estimator first. The result for the Chi-Square Goodness of Fit test indicated a lack of fit, $\chi^2(813, N = 580) = 2710.26$, $p < .001$. Lack of fit was also indicated by the low values for the robust CFI (.86) and the robust TLI (.85). The value for the robust RMSEA was slightly above the recommended cutoff value of .06 (RMSEA = .068, 90% CI = .065, .070). The robust SRMR was the only index that indicated a good fit (SRMR = .056). Overall the hypothesized model from Study 1 was not a good fit for the sample data from Study 2.

Modication indices were examined to determine if freeing any parameters in the model would improve model fit. Error terms were allowed to correlate if it made sense that the items would be related and if doing so would significantly improve model fit. For example, item 13 "People should tell their teacher if they know someone is taking a cognitive enhancing drug at school" was allowed to correlate with item 25 "People should tell their boss if they know someone is taking a cognitive enhancing drug at work". The wording of the items was similar and both dealt with whether users of cognitive enhancing drugs should be reported to authorities. A total of 10 error term correlations were added to the model. For the modified model see Figure 4. After the modifications were made, the Chi-Square Goodness of Fit remained significant, $\chi^2(803, N = 580) = 1923.33$, $p < .001$. The other fit indexes, however, showed improvement, robust CFI = .92, robust TLI = .91, robust RMSEA = .052 (90% CI = .049, .055), robust SRMR = .055. The robust RMSEA and SRMR values indicated a good fit. The robust CFI and TLI values indicated an adequate fit. To determine if the second model fit the sample

Figure 4

Model 2 of the Attitudes Toward Pharmacological Cognitive Enhancement Scale



data significantly better than the first model a Satorra-Bentler Scaled Chi-Square Difference Test was conducted. A standard chi-square difference test can not be used because the difference between two robust Chi-Square Goodness of Fit Test statistics does not have a chi-square distribution (Brown, 2006). Compared to the first model, the

second model fit the sample data significantly better, scaled $\Delta\chi^2$ (10, N = 580) = 489.79, $p < .001$.

A confirmatory factor analysis was then conducted with the WLSMV estimator. The hypothesized model was the four-component structure of the revised ATPCE Scale identified in Study 1 without any modifications (Figure 3). The Chi-Square Goodness of Fit Test was significant indicating a poor fit, $\chi^2(813, N = 580) = 1768.77$, $p < .001$. The values for all the other fit indices, however, indicated that the hypothesized model fit the sample data well, robust CFI = .99, robust TLI = .99, robust RMSEA = .045 (90% CI = .041, .046), robust SRMR = .053.

Evidence of adequate or good fit were obtained using two different methods of parameter estimation and multiple fit indices. Using the MLR estimator, modifications had to be made to the hypothesized model in order to obtain an adequate fit, but with the WLSMV estimator no modifications had to be made. The results from the confirmatory factor analyses provide initial support for the reliability of the four-component structure identified in Study 1 for the revised ATPCE Scale (Cheating/Unfairness, Motivation, Expected Benefits and Safety).

Internal Consistency of the ATPCE Scale

Cronbach's alpha was calculated for each of the four components of the revised ATPCE Scale. As in Study 1, internal consistency was high for the Cheating/Unfairness ($\alpha = .93$; 95% CI: .92, .95), Motivation ($\alpha = .95$; 95% CI: .93, .96) and Expected Benefits ($\alpha = .89$; 95% CI: .87, .92) subscales. The internal consistency for the Safety subscale ($\alpha = .70$; 95% CI: .63, .77) was moderate, but higher than in Study 1.

Construct Validity Analyses

To further explore the construct validity of the revised ATPCE Scale, mean scores for the participants on each of the four subscales were calculated and compared to their scores on other variables that were expected to be related. The intercorrelations between the ATPCE subscales and the means and standard deviations for each of the subscales are presented in Table 9. The correlations between the ATPCE subscales were moderate and all were statistically significant ($p < .001$). The bivariate relationships between the ATPCE subscales and other study variables are presented in Table 10. Also the mean score of users ($n = 48$) on each of the ATPCE subscales was compared to that of nonusers ($n = 508$). As there were so few nonmedical users ($n = 25$) the user group included the nonmedical users and the over-the-counter users ($n = 23$). The medical users ($n = 24$) were excluded as they were taking prescription drugs for a diagnosed medical condition and not for cognitive enhancement purposes.

Before performing the analyses normality was assessed for each variable by examining the histogram for the variable and the normal Q-Q plot. Boxplots were used to look for potentially influential outliers. For analyses that involved comparing group means, homogeneity of variance was assessed using the Brown-Forsythe test. For bivariate analyses scatterplots were examined to assess if there was evidence of a linear or monotonic relationship between the variables. The confidence intervals for analyses that involved Spearman's rank correlation coefficients were determined using bias-corrected and accelerated (BCA) bootstrapping (2000 samples were used). As many comparisons were performed, Bonferroni correction was applied to reduce the chances of Type 1 error. The p value was set to .002 ($p = .05 / 23$ comparisons = .002). The results

Table 9

Intercorrelations, Means and Standard Deviations for the ATPCE Subscales

	Motivation	Expected Benefits	Safety	*M*	*SD*
Cheating/Unfairness	-.67*	-.50*	.53*	4.19	1.17
Motivation		.63*	-.55*	2.93	1.57
Expected Benefits			-.31*	3.47	1.11
Safety				5.35	1.10

*$p < .001$

Table 10

Correlations Between the ATPCE Subscales *and Study Variables*

	Cheating/ Unfairness	Motivation	Expected Benefits	Safety	*M*	*SD*
EPQ Idealism	.20*				69.46	10.70
PEAS Cheating/Fairness Items	-.34*				12.92	4.72
PSS-10		.25*			22.14	7.08
Cognitive Abilities Rating		-.20*			3.33	.65
Academic Performance Rating		-.25*			4.39	1.6
Attention Rating		-.34*			4.43	1.52
Memory Rating		-.25*			4.44	1.59
POS Instrumental/ Positive Beliefs			.33*		56.70	16.80
PSEQII Cognitive Enhancement			.29*		35.15	16.61
PEAS Safety Items				-.19*	5.21	1.88
POS Side Effects				.12	29.45	7.08
Amount Willing to Spend	-.48*	.65*	.48*	-.32*		

Note. EPQ = Ethics Position Questionnaire; PEAS = Performance Enhancement Attitudes Scale; PSS-10 = Perceived Stress Scale; POS = Pharmacological Optimism Scale; PSEQII = Prescription Stimulant Expectancy Questionnaire
*$p < .001$

for each of the ATPCE subscales will be discussed separately.

Cheating/Unfairness Subscale. The Cheating/Unfairness subscale had 19 items developed to assess attitudes about whether it is cheating or unfair for healthy people to use cognitive enhancing drugs. It was hypothesized that there would be a statistically significant positive correlation between participants' scores on the Cheating/Unfairness subscale and their scores on the Idealism subscale of the EPQ (Forsyth, 1980). Three participants provided no data for the Idealism subscale and were removed from the analysis. One additional participant missed one item (10% of Idealism subscale) and the missing data were replaced with the item mean. Although small, there was a statistically significant positive correlation between participants' scores on the Cheating/Unfairness subscale and their scores on the Idealism subscale of the EPQ, $r(575) = .20$, $p < .001$ (95% CI: .12, .27). Participants with higher idealism were morely likely to judge nonmedical use of cognitive enhancing drugs as cheating or unfair.

It was also hypothesized that there would be a statistically significant negative correlation between the participants' scores on the Cheating/Unfairness subscale and their scores on items from the PEAS (Petróczi & Aidman, 2009) dealing with cheating and fairness. There were no missing data from the PEAS. Seven items from the PEAS (Items 2, 5, 13, 14, 15, 16 and 17) were judged to be dealing with whether it is cheating or unfair for athletes to take performance-enhancing drugs. Participants' scores on these items were combined to create a composite score. The distribution of the composite scores deviated considerably from normal ($Z_{skewness} = 10.03$, $Z_{kurtosis} = 9.12$), so a Spearman's rank correlation coefficient was used. As had been predicted there was a statistically significant negative correlation between the participants' scores on the

Cheating/Unfairness subscale and their scores on items from the PEAS dealing with cheating and fairness, r_s = -.34, p < .001 (95% CI: -.41, -.28). The correlation was moderate. Participants who were less concerned about whether it cheating or unfair for healthy people to use cognitive enhancing drugs also tended to be less concerned about whether it is cheating or unfair for athletes to use performance-enhancing drugs.

A Spearman's rank correlation coefficient was calculated between the participants' score on the Cheating/Unfairness subscale and the amount they were willing to spend per month on a cognitive enhancing drug. As predicted there was a statistically significant negative correlation between the amount participants were willing to spend per month and their scores on the Cheating/Unfairness subscale, r_s = -.48, p < .001 (95% CI: -.54, -.41). The correlation was moderate. Participants who were less concerned that it was cheating or unfair for healthy people to use cognitive enhancing drugs tended to be willing to spend more money. The analysis was run again after removing the participants (n = 274) who indicated they were not interested in taking a drug to enhance their cognitive abilities. The magnitude of the correlation could be affected by the skewness in the data (i.e., the inclusion of many 0s). With these participants removed, the correlation between how much the participants were willing to spend and their scores on the Cheating/Unfairness subscale was reduced but still statistically significant, r_s = -.18, p = .002 (95% CI: -.29, -.07).

A *t*-test was conducted to compare the mean score of users to nonusers on the Cheating/Unfairness subscale. As predicted, participants who had used prescription or over-the-counter drugs for cognitive enhancement purposes (M = 3.24, SD = 1.09) showed less concern that it was cheating or unfair for healthy people to use cognitive

enhancing drugs and scored statistically significantly lower on the Cheating/Unfairness subscale than participants who had never used drugs for cognitive enhancement purposes ($M = 4.33$, $SD = 1.12$), $t(554) = -6.45$, $p < .001$. The effect of group membership (users versus nonusers) on the mean score for the Cheating/Unfairness subscale was large, $d = -0.99$.

Motivation Subscale. The Motivation subscale had 10 items developed to assess how motivated an individual was to use cognitive enhancing drugs. It was expected that participants' scores on the Motivation subscale would be statistically significantly positively correlated with their scores on the PSS-10 (Cohen & Williamson, 1988). Two participants were missing all of the PSS-10 data and were removed from the analysis. One participant missed one item (10%) and the missing score was replaced with the item mean. As expected there was a statistically significant positive correlation between the participants' scores on the Motivation subscale and their scores on the PSS-10, $r(576) = .25$, $p < .001$ (95% CI: .17, .32). Participants who perceived their life as more stressful tended to have higher motivation to use cognitive enhancing drugs, however, the correlation was small.

A series of Spearman's rank correlation coefficients were calculated between the participants' scores on the Motivation subscale and their ratings of their current cognitive abilities (Well Below Average to Well Above Average) and their level of satisfaction with their current academic performance, ability to pay attention and ability to remember (Very Dissatisfied to Very Satisfied). None of the ratings data were missing. As hypothesized participants' scores on the Motivation subscale were statistically significantly negatively correlated with their ratings of their current cognitive abilities, r_s

= -.20, $p < .001$ (95% CI: -.29, -.12). Participants who rated their current cognitive abilities lower tended to have higher motivation to use cognitive enhancing drugs, although the correlation was small. Participants' Motivation scores were also statistically significantly negatively correlated with their level of satisfaction with their current academic performance, $r_s = -.25$, $p < .001$ (95% CI: -.33, -.17). Although the correlation was small, participants who were less satisfied with their performance tended to have higher motivation to use cognitive enhancing drugs. Also as predicted the participants' scores on the Motivation subscale were statistically significantly negatively correlated with their level of satisfaction with the current ability to pay attention, $r_s = -.34$, $p < .001$ (95% CI: -.40, -.26). This correlation was moderate. Participants who were less satisfied with their ability to pay attention were more likely to have higher motivation to use cognitive enhancing drugs. A statistically significant negative correlation was found between participants' Motivation scores and their level of satisfaction with their current ability to remember, $r_s = -.25$, $p < .001$ (95% CI: -.33, -.16), although the correlation was small. Participants who were less satisfied with their memory were more likely to have higher motivation to use cognitive enhancing drugs.

A Spearman's rank correlation coefficient was calculated between the participants' scores on the Motivation subscale and the amount they were willing to spend per month on a cognitive enhancing drug. As predicted there was a statistically significant positive correlation between the amount participants were willing to spend per month and their scores on the Motivation subscale, $r_s = .65$, $p < .001$ (95% CI: .60, .70). The correlation was moderate. Participants who were more highly motivated to use cognitive enhancing drugs tended to be willing to spend more money. The analysis was

run again after removing the participants (n = 274) who indicated they were not interested in taking a drug to enhance their cognitive abilities. With these participants removed, the correlation between how much the participants were willing to spend and their scores on the Motivation subscale was no longer statistically significant, r_s = .15, p = .009 (95% CI: .03, .27) according to the corrected significance level of p = .002.

A *t*-test was conducted to compare the mean score of users to nonusers on the Motivation subscale. As hypothesized, participants who had used prescription or over-the-counter drugs for cognitive enhancement purposes (M = 4.37, SD = 1.53) tended to have greater motivation to use cognitive enhancing drugs and scored statistically significantly higher on the Motivation subscale than participants who had never used drugs for cognitive enhancement purposes (M = 2.70, SD = 1.46), $t(554) = 7.56$, $p < .001$. The effect of group membership (users versus nonusers) on the mean score for the Motivation subscale was large, d = 1.12.

Expected Benefits Subscale. The Expected Benefits subscale had 9 items developed to assess attitudes toward the possible benefits to individuals and society from using cognitive enhancing drugs. It was predicted that participants' scores on the Expected Benefits subscale would be statistically significantly positively correlated with their scores on the Instrumental/Positive Beliefs subscale of the POS (Kenna & Wood, 2008). Three participants were missing all of the data from the Instrumental/Positive Beliefs subscale and were removed from the analysis. One participant was missing 2 items (9.52% of subscale) and 3 participants were missing 1 item each (4.76% of subscale). The missing data were replaced with item means. The data from the Instrumental/Positive Beliefs subscale was moderately negatively skewed ($Z_{skewness}$ =

8.46), so a Spearman's rank correlation coefficient was used. As expected there was a statistically significant positive correlation between the participants' scores on the Expected Benefits subscale and their scores on Instrumental/Positive Beliefs subscale of the POS, r_s= .33, p < .001 (95% CI: .25, .40). The correlation was moderate. Participants who had higher expectations for the benefits of using cognitive enhancing drugs were more likely to have higher expectations about the effects of prescription drugs in general.

It was predicted that participants' scores on the Expected Benefits subscale would be also be statistically significantly positively correlated with their scores on the Cognitive Enhancement subscale of the PSEQII (Looby & Earlywine, 2010). One participant was missing all of the data from the Cognitive Enhancement subscale and was removed from the analysis. Two participants were missing 1 item each (5.00% of subscale) and the missing data were replaced with item means. As predicted there was a statistically significant positive correlation between the participants' scores on the Expected Benefits subscale and their scores on the Cognitive Enhancement subscale of the PSEQII, $r(577) = .29$, p < .001 (95% CI: .21, .36). The correlation though was small. Participants who had higher expectations of the benefits of using cognitive enhancing drugs were more likely to have higher expectations about the cognitive enhancing effects of prescription stimulants.

A Spearman's rank correlation coefficient was calculated between the participants' scores on the Expected Benefits subscale and the amount they were willing to spend per month on a cognitive enhancing drug. As expected there was a statistically significant positive correlation between the amount participants were willing to spend per month and their scores on the Expected Benefits subscale, r_s =.48, p < .001 (95% CI: .41,

.54). The correlation was moderate. Participants who expected greater benefits from using cognitive enhancing drugs tended to be willing to spend more money. The analysis was run again after removing the participants (n = 274) who indicated they were not interested in taking a drug to enhance their cognitive abilities. With these participants removed, the correlation between how much the participants were willing to spend and their scores on the Expected Benefits subscale was reduced but still statistically significant, r_s = .18, p = .001 (95% CI: .07, .30).

A *t*-test was conducted to compare the mean score of users to nonusers on the Expected Benefits subscale. It was expected that users would have greater expectations for the benefits of cognitive enhancing drugs and would score statistically significantly higher on the Expected Benefits subscale than nonusers. This hypothesis was not supported even after removing potentially influential outliers (1 in user group, 4 in nonuser group), so the outliers were left in the analysis. Although participants who had used prescription or over-the-counter drugs for cognitive enhancement purposes (M = 3.85, SD = 1.06) scored higher on the Expected Benefits subscale than participants who had never used drugs for cognitive enhancement purposes (M = 3.39, SD = 1.08), the difference was not significant, $t(554) = 2.79$, p = .005 according to the corrected significance level of p = .002. The effect of group membership (users versus nonusers) on the mean score for the Expected Benefits subscale was small-to-moderate, d = 0.43.

Safety Subscale. The Safety subscale had 4 items and was developed to assess attitudes toward the safety of cognitive enhancing drugs. It was predicted that participants' scores on the Safety subscale would be statistically significantly negatively correlated with their scores on items of the PEAS (Petróczi, & Aidman, 2009) dealing

with the safety of using performance-enhancing drugs. There were no missing data from the PEAS. Two items from the PEAS (Items 3 and 7) dealt specifically with the safety of using performance enhancing drugs. Participants' scores on these two items were combined to create a composite score. As predicted there was a statistically significant negative correlation between the participants' scores on the Safety subscale and their scores on the safety items from the PEAS, $r(578) = -.19$, $p < .001$ (95% CI: -.26, -.11). Although the correlation was small, participants who had greater concern about the safety of cognitive enhancing drugs tended to have greater concern about the safety of performance-enhancing drugs.

It was predicted that participants' scores on the Safety subscale would be also be significantly positively correlated with their scores on the Side Effects subscale of the POS (Kenna & Wood, 2008). Three participants were missing 75% or more of the data from the Side Effects subscale and were removed from the analysis. Two participants was missing 1 item each (11.11% of subscale) and the missing data were replaced with item means. The POS Side Effects data deviated considerably from normal ($Z_{skewness} = 8.62$, $Z_{kurtosis} = 4.72$), so a Spearman's rank correlation coefficient was calculated between the Safety subscale scores and the POS Side Effects scores. The hypothesis was not supported. Although there was a positive correlation between the participants' scores on the Safety subscale and their scores on the Side Effects subscale of the POS, it was not statistically significant, $r_s = .12$, $p = .004$ (95% CI: .04, .20) according to the corrected significance cutoff of $p = .002$.

A Spearman's rank correlation coefficient was calculated between the participants' score on the Safety subscale and the amount they were willing to spend per

month on a safe and effective cognitive enhancing drug. As predicted there was a statistically significant negative correlation between the amount participants were willing to spend per month and their scores on the Safety subscale, $r_s = -.32$, $p < .001$ (95% CI: -.39, -.23). The correlation was moderate. Participants who had fewer concerns about the safety of cognitive enhancing drugs tended to be willing to spend more money. The analysis was run again after removing the participants ($n = 274$) who indicated they were not interested in taking a drug to enhance their cognitive abilities. With these participants removed, the correlation between how much the participants were willing to spend and their scores on the Safety subscale was no longer statistically significant, $r_s = -.05$, $p > .05$ (95% CI: -.16, .07).

A *t*-test was conducted to compare the mean score of users to nonusers on the Safety subscale. It was expected that users would be less concerned about the safety of cognitive enhancing drugs than nonusers. Participants who had used prescription or over-the-counter drugs for cognitive enhancement purposes ($M = 4.54$, $SD = 1.34$) scored statistically significantly lower on the Safety subscale than participants who had never used drugs for cognitive enhancement purposes ($M = 5.49$, $SD = 1.00$), $t(554) = -6.10$, $p < .001$. As the group variances were statistically signficantly different, a Welch's *t*-test was also conducted, but the results were the same. A statistically significant difference was found between the two means ($p < .001$), so only the results for the *t*-test are reported here. The effect of group membership (users versus nonusers) on the mean score for the Safety subscale was large, $d = -0.80$.

Discussion

The purpose of the Study 2 was to provide additional evidence for the reliability

of the four-component structure of the revised ATPCE Scale identified in Study 1 and for the construct validity of the scale. The results from the confirmatory factor analyses provided support for the reliability of the four-component structure (Cheating/Unfairness, Motivation, Expected Benefits, and Safety). Using a weighted least squares means and variances adjusted estimator (WLSMV) the hypothesized model fit the data from an independent university student sample adequately based on four different fit indices (robust CFI, robust TLI, robust RMSEA and robust SRMR) without further modifications. Using a robust maximum likelihood estimator adequate fit was obtained after adding 10 error-term correlations to the hypothesized model.

The Cronbach's alpha values obtained for each of the four subscales of the revised ATPCE Scale provided additional evidence for the internal consistency of the scale. As with Study 1, the alpha values obtained for the Cheating/Unfairness, Motivation, and Expected Benefits subscales were all greater than .80, indicating good internal consistency (Field et al., 2012). The alpha value obtained for the Safety subscale ($\alpha = .70$) was considerably higher than in Study 1 ($\alpha = .63$), and indicated adequate internal consistency (Field et al., 2012).

There was substantial evidence for the construct validity of the Cheating/Unfairness subscale. All of the hypotheses were supported. Participants' scores on the Cheating/Unfairness subscale were statistically significantly negatively correlated with their scores on items of the Performance Enhancement Attitude Scale (PEAS; Petróczi & Aidman, 2009) dealing with cheating and fairness. Participants who were less concerned that it was cheating or unfair for healthy adults to use prescription drugs for cognitive enhancement also tended to be less concerned that it was cheating or

unfair for athletes to use performance-enhancing drugs. The correlation was moderate. This result was consistent with previous research findings that individuals tend to make similar moral judgements about the use of drugs for enhancement purposes, whether it is for cognitive enhancement or for performance enhancement in sports (Partridge et al., 2012). Although the correlation was small, participants with higher levels of idealism as measured by the Idealism subscale of the Ethics Position Questionnaire (EPQ; Forsythe, 1980) were more likely to score higher on the Cheating/Unfair subscale, indicating greater concern that it is cheating or unfair for healthy adults to use cognitive enhancing drugs. As in Study 1, when all participants were included in the analysis individuals who scored lower on the Cheating/Unfairness subscale tended to be willing to spend more money per month on a safe and effective cognitive enhancing drug. The correlation was moderate. It remained statistically significant even after removing participants who indicated they were not interested in taking a drug to enhance their cognitive abilities. Also as in Study 1, scores on the Cheating/Unfairness subscale differentiated users (participants who had taken a prescription or over-the-counter drug during their lifetime for cognitive enhancement) and nonusers (participants who had not taken a prescription or over-the-counter drug during their lifetime for cognitive enhancement). Users were less concerned about the fairness of healthy people using cognitive enhancing drugs and scored statistically significantly lower on the Cheating/Unfairness subscale than nonusers. Group membership (user versus nonuser) had a large effect on the mean score for the Cheating/Unfairness subscale.

There was also substantial evidence for the construct validity of the Motivation

subscale. All of the hypotheses were supported. Although the correlation was small, participants who scored higher on the Motivation subscale, indicating greater motivation to use cognitive enhancing drugs were more likely to report higher levels of perceived stress as measured by the Perceived Stress Scale (PSS-10; Cohen & Williamson, 1988). Higher levels of perceived stress has been associated with nonmedical use of drugs for cognitive enhancement purposes in students (Liakoni et al., 2015; Sattler, 2019; Wolff & Brand, 2013). Higher scores on the Motivation subscale were also found to be associated with lower ratings of current cognitive abilities, and lower satisfaction ratings with current academic performance, ability to remember, and ability to pay attention. The correlations were small to moderate. These results were consistent with research findings that have associated nonmedical use with lower grades (Arria et al., 2013; Bavarian et al., 2013, 2014; Benson et al., 2015; Lucke et al., 2018**)** and self-reported problems with attention (Arria et al., 2011; Rabiner et al., 2009, 2010). As in Study 1, when all participants were included in the analysis individuals with higher scores on the Motivation subscale tended to be willing to spend more money per month on a safe and effective cognitive enhancing drug. The correlation was moderate. Also as in Study 1, scores on the Motivation subscale differentiated users and nonusers. Users had greater motivation to use cognitive enhancing drugs and scored statistically significantly higher on the Motivation subscale than nonusers. The effect size was large.

There was some evidence for the construct validity of the Expected Benefits subscale. Participants who scored higher on the Expected Benefits subscale, indicating greater expectations for the benefits of cognitive enhancing drugs tended to have greater expectations for the benefits of prescription drugs in general and scored statistically

significantly higher on the Instrumental/Positive Beliefs subscale of the Pharmacological Optimism Scale (POS; Kenna & Wood, 2008) and the Cognitive Enhancement subscale of the Prescription Stimulant Expectancy Questionnaire (PSEQII; Looby & Earlywine, 2010). The correlations were small to moderate. As in Study 1, when all participants were included in the analysis individuals with higher scores on the Expected Benefits subscale tended to be willing to spend more money per month on a safe and effective cognitive enhancing drug. This correlation was moderate and it remained statistically significant even after removing the participants who indicated they were not interested in taking a drug to enhance their cognitive abilities. Although users scored higher on the Expected Benefits subscale than nonusers, the difference was not statistically significant. A very conservative significance level was used ($p = .002$). Also, the user group was very small ($n = 48$) in comparison to the nonuser group ($n = 508$) and the mean score of the users on the Expected Benefits subscale was quite low ($M = 3.85$ on a 7-point Likert scale). With a larger number of participants who had used prescription or over-the-counter drugs for cognitive enhancement purposes there might have been more users with greater expectations and higher scores on the Expected Benefits subscale.

There was also some evidence for the construct validity of the Safety subscale. Participants' scores on the Safety subscale were statistically significantly negatively correlated with their scores on items from the PEAS dealing with safety. Participants who had greater concern about the safety of cognitive enhancing drugs tended to have greater concern about the safety of performance-enhancing drugs. Partridge et al. (2014) reported that many of their participants expressed concerns about the safety of using drugs for cognitive enhancement and performance enhancement in sports. As in Study 1,

when all the participants were included in the analysis individuals with lower scores on the Safety subscale, indicating lesser concern about the safety of cognitive enhancing drugs tended to be willing to spend more money per month on a safe and effective cognitive enhancing drug. Also as in Study 1, scores on the Safety subscale differentiated users and nonusers. Users had less concern about safety and scored statistically significantly lower on the Safety subscale. The effect size was large. Although there was a positive correlation between participants' scores on the Safety subscale and their scores on the Side Effects subscale of the Pharmacological Optimism Scale (POS; Kenna & Wood, 2008), the correlation was not statistically significant. Many of the items from the Side Effects subscale dealt with specific physical symptoms an individual might experience when using different types of prescription drugs (e.g., sleepiness, headache, feeling jittery), whereas the items in the Safety subscale dealt with more general concerns about safety (e.g., "There may be long-term risks and side effects of taking a cognitive enhancing drug"). The content of the two subscales may have been too dissimilar to find a statistically significant correlation.

Study 3

The purpose of Study 3 was to investigate the test-retest reliability of the ATPCE Scale. Participants completed the revised ATPCE Scale at two different time points with a minimum of 3 weeks elapsing between Time 1 and Time 2. It was expected that the test-retest reliability for each of the ATPCE subscales would be .70 or greater. Also for each of the subscales it was expected that there would be no statistically significant difference between the participants' mean score at Time 1 and their mean score at Time 2.

Method

Participants

As in the previous studies the SONA participant management system was used to recruit participants from first-year introductory psychology courses and second-year research methods and statistics in psychology courses at Trent University. Students who had participated in either of the two previous studies were excluded. A total of 182 undergraduate students participated at Time 1. Participants were excluded from participating at Time 2 if they failed to provide any data for the ATPCE Scale items (4 participants or 2.20%) or if they responded inappropriately to two questions that required a specific response (22 participants or 12.09%). Of the 156 participants invited back for Time 2 (after a 3-week interval), 64 (41.03%) returned to complete the study. The data from 2 of these participants (1.28%) were also excluded due to inappropriate responding. The final sample consisted of 62 participants (39.74% of the 156 invited back at Time 2). Demographic information for the 156 participants invited back to complete Time 2 is provided in the Results. The Research Ethics Board of Trent University approved this study. Participants were compensated with 0.5 bonus course credits at Time 1 and 0.25 bonus course credits and a $5 eGift card at Time 2. Students who chose not to participate in psychology research projects were given the option to complete a written report for bonus course credit.

Measures

Participants completed the demographics questionnaire and the revised ATPCE Scale described in Study 2 (Appendices D and E).

Procedure

Students were notified of the opportunity to participate in the study through the psychology department's online participant management system (SONA). Potential participants were provided with a brief description of the study with information on approximately how long it would take to complete each part online (20 minutes for Time 1 and 10 minutes for Time 2) and the compensation for participating (0.5 bonus course credits for Time 1, 0.25 bonus course credits for Time 2, and a $5 Amazon eGift card for completing both parts and answering correctly two questions that required a specific response) (Appendix J). Individuals who wished to participate clicked on the link provided and were taken to the Qualtrics Survey System website to complete a consent form (Appendix K). Those who clicked *Agree* on the consent form had an opportunity to complete the questionnaires. The demographics questionnaire was presented first and then the revised ATPCE Scale. When the participant had completed both questionnaires or had withdrawn, a form was provided with information on Time 2 (Appendix L). In the form it was explained that those who had completed Time 1 of the study and had correctly answered the two questions that required a specific response would receive an email in 3 weeks with information on signing up for and completing Time 2. Three weeks after completing Time 1, eligible participants were sent a message through the SONA system to their email address asking them to sign up for and complete Time 2 and providing them with a required password (Appendix M). Only eligible participants were provided with the password to prevent unauthorized individuals from signing up. If participants did not complete Time 2 within a week, a second message was sent reminding them to complete it (Appendix M). No additional reminders were sent after

that. Participants who signed up for Time 2 were taken to the Qualtrics Survey System website to complete the revised ATPCE Scale again. After they had completed the questionnaire or withdrawn, a debriefing form was provided to explain the purpose of the study and to provide contact information for the researchers and for counselling services, if needed (Appendix N). Every 2 weeks the SONA id numbers of those eligible for the $5 eGift card were emailed to the administrator of the SONA system in order to obtain the participants names and email addresses. The administrator was the only one who had access to this information. The names and email addresses were emailed back in random order (not in the same order the SONA id numbers were listed) so that the researchers could not associate names and email addresses with particular SONA id numbers. The Amazon eGift cards were purchased and emailed to the eligible participants.

Data Analyses

All data analyses were performed in R (Version 4.2.2; R Core Team, 2022). Cronbach's alpha was calculated for each of the revised ATPCE subscales at Time 1 to assess internal consistency. Normality was assessed for the subscale score data by examining the histogram for each variable and the normal Q-Q plot. Boxplots were used to look for potentially influential outliers. Scatterplots were examined to assess if there was evidence of a linear or monotonic relationship between the participants' scores at Time 1 and their scores at Time 2 for each of the subscales. Correlational analyses were conducted between the participants' scores at Time 1 and their scores at Time 2 to assess test-retest reliability over a minimum 3-week interval. For each subscale paired t-tests were performed to determine if there was a statistically significant difference between the mean scores at Time 1 and Time 2. Two-tailed paired t-tests were used.

Results

Demographics of the Sample

Demographic information for the 156 participants who completed Time 1 and were invited back to complete Time 2 is provided in Table 11. The participants ranged in age from 17 to 50 years (M = 21.19, SD = 6.44) and the majority were female (n = 132, 84.62%), white (n = 124, 79.49%) and in their first year of university (n = 110, 70.51%). Participants living on-campus made up 35.90% (n = 56) of the sample. Of the remaining participants, most were living off-campus with their family (n = 47, 30.13%) or with roommates (n = 32, 20.51%). The majority of the participants were not currently employed (n = 101, 64.74%) or were only employed part-time (n = 45, 28.85%). As in the previous two studies, reported household income varied with the two largest groups of participants representing the highest and lowest income levels. Participants with a reported household income under $10,000 a year comprised 12.99% (n = 20) of the sample, while those with a household income exceeding $100,000 made up 20.78% ($n$ = 32). As many of the participants were living at home with their family, some of them may have reported their parents' income rather than their own income.

Drug Use to Improve Cognitive Functioning

Of the 156 participants, only 22 (14.10%) indicated they had ever taken a prescription or over-the-counter drug to try and improve their cognitive functioning. Three participants (1.92%) reported having taken both prescription and over-the-counter drugs for that purpose. Information on the participants' use of prescription and over-the-counter drugs is provided in Table 12. When asked to list the prescription drug they had taken, 3 participants listed multiple drugs at the same time. In all 3 cases the drugs listed

Table 11

Demographic Characteristics of Sample Study 3 (N = 156)

Characteristic	*M* (*SD*)	*n*	%
Age	21.19(6.44)	156	
Gender			
Male		24	15.38
Female		132	84.62
Year of university			
1st year		110	70.51
2nd year		30	19.23
3rd year		7	4.49
4th year		7	4.49
5th year and beyond		2	1.28
Currently living			
At home with your family		47	30.13
On campus		56	35.90
Away from home with roommate(s)		32	20.51
Away from home with romantic partner		9	5.77
Away from home on your own		12	7.69
Current employment status			
Working full-time		10	6.41
Working part-time		45	28.85
Not working		101	64.74
Household income level (*n* = 154)			
Under $10,000		20	12.99
$10,000 to 19,000		16	10.39
$20,000 to 29,000		10	6.49
$30,000 to 39,000		9	5.84
$40,000 to 49,000		11	7.14
$50,000 to 59,000		4	2.60
$60,000 to 69,000		15	9.74
$70,000 to 79,000		7	4.55
$80,000 to 89,000		14	9.09
$90,000 to 99,000		16	10.39
Over $100,000		32	20.78
Ethnicity			
Caucasian/White		124	79.49
African/Black		7	4.49
Asian/Pacific Islander		14	8.97
Hispanic/Latino		2	1.28
Other		9	5.77

Note. Percentages may not add up to 100% due to rounding.

Table 12

Characteristics of Drug Use to Improve Cognitive Functioning Study 3 (*N* = 156)

Characteristic	Prescription Drugs (*n* = 15)		Over-the Counter Drugs (*n* = 10)	
	n	%	*n*	%
Lifetime use				
Yes	15	9.62	10	6.41
No	141	90.38	146	93.59
Past year use				
Yes	11	7.05	8	5.13
No	145	92.95	148	94.87
Frequency of use if used in the past year				
Daily	4	36.36	5	62.50
Weekly			2	25.00
Once a month	1	9.09		
Less than once a month	6	54.55	1	12.50
Drug effective in enhancing cognition				
Yes	10	66.67	6	60.00
No	5	33.33	4	40.00
Experienced unpleasant side effects				
Yes	6	40.00	2	20.00
No	9	60.00	8	80.00
Source of drug				
A doctor prescribed it to me	9	60.00		
A friend	5	33.33	2	20.00
A pharmacy			2	20.00
A health food store			8	80.00
Parent gave it to me				
Took from a family prescription	1	6.67		
The internet				
Other			1	10.00

Note. Percentages for Source of drug may add up to more than 100% because participants could list multiple drugs and multiple sources for each drug.

were of one type (prescription drugs only), so it was possible to analyze prescription drug use separately from over-the-counter drug use.

Prescription Drug Use. Fifteen of the 156 participants (9.62%) indicated they had used a prescription drug during their lifetime to try and improve their cognitive functioning. Although not included in Table 12, the most commonly reported prescription drugs used were Adderall (*n* = 5, 33.33% of prescription drug users), Ritalin (*n* = 4, 26.67% of prescription drug users), Concerta (*n* = 2, 13.33% of prescription drug users) and Vyvanse (*n* = 2, 13.33% of prescription drug users). All of these drugs are used in the treatment of ADHD. Modafinil had been taken by only 1 participant (6.67% of prescription drug users). One participant (6.67% of prescription drug users) listed a drug that was unexpected (marijauna which was legal only with a prescription at the time the study was conducted).

Of the 156 participants, 11 (7.05%) had taken at least one prescription drug in the past year to try and improve their cognition. As in the previous studies, the past-year users tended to use either daily (*n* = 4, 36.36% of past year users) or less than once a month (*n* = 6, 54.55% of past year users). The majority of the prescription drug users (*n* = 10, 66.67%) indicated that at least one of the prescription drugs they had taken had been effective in improving their cognition. Unpleasant side effects had been experienced by 6 (40.00%) of the prescription drug users. Side effects reported included headaches, dizziness, nausea, loss of appetite, increased heart rate, fatigue, problems urinating, muscles spasms, dry mouth, and mood disturbances.

Prescription drugs were obtained from three different sources. Nine participants (60.00% of prescription drug users) indicated the prescription drug(s) they had taken had been prescribed by a doctor. Five participants (33.33%) reported obtaining the drug(s)

from friends. One participant (6.67% of prescription drug users) indicated they had taken a drug from a family member's prescription.

Over-the-Counter Drug Use. Of the 156 participants, 10 (6.41%) indicated they had taken an over-the-counter drug during their lifetime to try and improve their cognitive functioning. Although not included in Table 12, the most commonly reported over-the-counter drugs used were ginseng (n = 5, 50.00% of over-the-counter drug users) and Gingko biloba (n = 3, 30.00% of over-the-counter drug users).

Eight of the 156 participants (5.13%) had taken at least one over-the-counter drug in the past year to try and improve their cognition. Among the past year users of over-the-counter drugs the most frequent use was daily for 5 participants (62.50% of past year users), weekly for 2 participants (25.00% of past year users), and less than once a month for 1 participant (12.50% of past year users). The majority of the over-the-counter drug users (n = 6, 60.00%) indicated that at least one of the drug(s) they had taken had been effective in improving their cognitive functioning. Unpleasant side effects had been experienced by only 2 (20.00%) of the over-the-counter drug users. Reported side effects included burping and insomnia. Most of the over-the-counter drug users obtained the drugs from healthfood stores (n = 8, 80.00%). Other sources included pharmacies (n = 2, 20.00%) and friends (n = 2, 20.00%).

User Groups. Based on the sources from which prescription drugs were obtained, 6 of the 156 participants (3.85%) were nonmedical users. Each of these participants had reported taking at least one prescription drug without a prescription to improve their cognitive functioning. Nine participants (5.77%) were medical users. These participants had reported a prescription for all of the prescription drugs they had

taken to try and improve their cognitive functioning. Three of the 10 participants who had taken an over-the-counter drug to improve their cognitive functioning had also taken a prescription drug and were categorized based on their prescription drug use. The other 7 participants (4.49%) were categorized as over-the-counter users as they had only taken over-the-counter drugs to improve their cognitive functioning. The remaining participants (n = 134, 85.90%) were nonusers.

Expected Benefits from a Safe and Effective Cognitive Enhancing Drug

As in the previous studies, the participants were asked to describe the benefits they would expect to gain if there were a safe and effective drug that could enhance their cognitive functioning. A response to this question was provided by 153 of the 156 participants at Time 1. Most of the participants expected benefits that were similar to what had been mentioned by the participants in the previous two studies, including greater ability to focus and concentrate, improved memory, greater productivity, better problem solving skills, greater motivation, increased alertness/wakefulness, better grades, faster processing of information, increased creativity, better job opportunities and less stress. A couple of expected benefits that not been mentioned specifically in the previous studies were better emotional management (2 participants) and improved blood circulation to the brain (2 participants). Three participants (1.96% of respondents) did not expect any benefit. Ten participants (6.54% of respondents) indicated they would not take a cognitive enhancing drug or expressed reservations about taking it. Some of these participants indicated they did not need a cognitive enhancing drug while others raised concerns about the safety of cognitive enhancing drugs or believed that only people with a legitimate medical reason should use them.

Motivation to Use a Safe and Effective Cognitive Enhancing Drug

Participants were asked how much money they would be willing to spend per month for a safe and effective cognitive enhancing drug. The results from Time 1 are presented in Table 13. As in the previous two studies, many of the participants had low motivation to use cognitive enhancing drugs. Nearly half the participants (n = 74, 47.44%) indicated they were not interested in taking a drug to enhance their cognitive abilities. Of the remaining participants most (n = 73, 46.81%) were willing to spend less than $60 a month. Only 3 participants (1.92%) indicated they would be willing to spend $100 or more a month.

Table 13

Amount Willing to Spend per Month for a Safe and Effective Cognitive Enhancing Drug Study 3 (N = 156)

Option	*n*	%
I am not interested in taking a drug to enhance my cognitive abilities.	74	47.44
$0 to $9	19	12.18
$10 to $19	18	11.54
$20 to $29	19	12.18
$30 to $39	5	3.21
$40 to $49	7	4.49
$50 to $59	5	3.21
$60 to $69	2	1.28
$70 to $79	2	1.28
$80 to $89	1	.64
$90 to $99	1	.64
$100 or more	3	1.92

Internal Consistency of the ATPCE Scale

Cronbach's alpha was calculated for each of the four ATPCE subscales based on the data from Time 1. As in the previous studies, internal consistency was high for the

Cheating/Unfairness (α = .94; 95% CI: .92, .97), Motivation (α = .94; 95% CI: .90, .98) and Expected Benefits (α = .81; 95% CI: .74, .88) subscales. The internal consistency for the Safety subscale (α = .74; 95% CI: .62, .87) was moderate, but higher than in either of the previous studies (α = .63 in Study 1; α = .70 in Study 2).

Test-Retest Reliability of the ATPCE Scale

The participants from Time 1 were invited back after a 3-week interval to complete the revised ATPCE Scale items a second time. Sixty-four of 156 participants (41.03%) returned and completed the study at Time 2. The participants who completed Time 2 did not differ significantly from those who did not complete Time 2 on any of the demographic variables (age, gender, year of university, where currently living, employment status, household income, ethnicity), the composition of the user groups (nonmedical user, over-the-counter user, medical user or nonuser) or mean scores on the ATPCE subscales ($p > .05$ for all). Data from 2 of the 64 participants were removed from the analysis as they incorrectly answered the two questions that required a specific response (strike questions). There were no missing data from the remaining 62 participants. The interval between completion of the ATPCE Scale at Time 1 and completion of the scale at Time 2 ranged from 21 days to 138 days. The average interval time for completion was 29 days.

Before conducting the analyses, normality was assessed for each of the Time 1 and Time 2 ATPCE subscale score distributions by examining the histogram and normal Q-Q plot for the variable. Boxplots were used to look for potentially influential outliers. Scatterplots were examined to assess if there was evidence of a linear or monotonic relationship between the Time 1 and Time 2 scores.

It was hypothesized that test-retest reliability for each to the ATPCE subscales would be .70 or greater. This hypothesis was supported for the Cheating/Unfairness subscale, $r(60) = .86$, $p < .001$ (95% CI: .77, .91). It was also supported for the Motivation subscale, $r(60) = .88$, $p < .001$ (95% CI: .81, .93) and the Safety subscale, $r(60) = .75$, $p < .001$ (95% CI: .62, .84). It was not supported for the Expected Benefits subscale, $r(60) = .69$, $p < .001$ (95% CI: .53, .80), although the correlation was very close to the .70 cutoff value recommended by Leary (2012) as evidence of good test-retest reliability. Test-retest reliability was strong for the Cheating/Unfairness, Motivation and Safety subscales of the ATPCE Scale. Test-retest reliability was weaker for the Expected Benefits subscale.

For each of the ATPCE subscales it was expected that there would be no statistically significant difference between the participants' mean score at Time 1 and their mean score at Time 2. This hypothesis was supported for each of the four subscales. For the Cheating/ Unfairness subscale there was no significant difference between the participants' mean score at Time 1 ($M = 4.19$, $SD = 1.22$) and their mean score at Time 2 ($M = 4.22$, $SD = 1.21$), $t(61) = -.38$, $p > .05$, $d = 0.02$. For the Motivation subscale there was also no significant difference between their mean score at Time 1 ($M = 3.05$, $SD = 1.57$) and their mean score at Time 2 ($M = 3.00$, $SD = 1.65$), $t(61) = .50$, $p > .05$, $d = -0.03$. There was no significant difference between their mean score at Time 1 ($M = 3.71$, $SD = .86$) and their mean score at Time 2 ($M = 3.89$, $SD = .99$) for the Expected Benefits subscale either, $t(61) = -1.91$, $p > .05$, $d = 0.19$. For the Safety subscale there was also no signficant difference between their mean score at Time 1 ($M = 5.41$, $SD = 1.18$) and their mean score at Time 2 ($M = 5.48$, $SD = 1.22$), $t(61) = -.72$, $p > .05$, $d = 0.06$. The

mean difference scores from Time 1 to Time 2 were quite small; the Cohen's *d* values were all less than 0.20, which is considered to be a small effect (Cohen, 1988).

Discussion

The primary purpose of Study 3 was to investigate the test-retest reliability of the revised ATPCE Scale. There was no statistically significant differences between the participants' mean scores on the four subscales at Time 1 and their mean scores at Time 2. The Cheating/Unfairness, Motivation and Safety subscales had good test-retest reliability over a minimum 3-week interval with correlations between the participants' scores at Time 1 and their scores at Time 2 above .70. Although weaker, the test-retest reliability of the Expected Benefits subscale (.69) was very close to the cutoff value of .70. Although the minimum time interval between Time 1 and Time 2 was 3 weeks, some participants took much longer to complete Time 2 (up to 138 days). This could have decreased the test-retest reliability of the Expected Benefits subscale and the other subscales.

The Cronbach's alpha values obtained for ATPCE subscales at Time 1 provided additional evidence for the internal consistency of the scale. As in Studies 1 and 2, the Cronbach's alpha values for the Cheating/Unfairness, Motivation and Expected Benefits subscales were all greater than .80, indicating good internal consistency (Field et al., 2012). The value obtained for the Safety subscale ($\alpha = .74$) indicated adequate internal consistency (Field et al., 2012).

General Discussion

The purpose of this project was to develop a valid and reliable scale to measure public attitudes toward pharmacological cognitive enhancement (i.e., the ATPCE Scale).

There is currently no valid and reliable scale that has been published to assess these attitudes, leaving researchers to use their own individual questions or scales across studies. In Study 1 principal components analysis was used to reduce the number of scale items from 90 to 42 and a four-component structure was identified: Cheating/Unfairness (19 items), Motivation (10 items), Expected Benefits (9 items) and Safety (4 items). Scores on these four subscales differentiated users and nonusers of drugs for cognitive enhancement. Furthermore, when all participants were included in the analyses, statistically significant correlations were found between participants' scores on the subscales and the amount they were willing to spend per month on a safe and effective cognitive enhancing drug, providing some initial validation for the scale.

In Study 2 the revised 42-item ATPCE Scale was administered to an independent sample of undergraduate students and results from the confirmatory factor analyses provided support for the reliability of the four-component structure. Most of the hypotheses developed to investigate the construct validity of the revised scale were supported. Higher scores on the Cheating/Unfairness subscale were associated with higher levels of idealism and greater concern that it is cheating or unfair for athletes to use performance-enhancing drugs. Higher scores on the Motivation subscale were associated with higher levels of perceived stress, lower ratings of cognitive abilities and lower satisfaction ratings of academic performance, ability to pay attention and ability to remember. Higher scores on the Expected Benefits subscale were associated with greater expections about the benefits of prescription stimulants and prescription drugs in general. Higher scores on the Safety subscale were associated with greater concern about the safety of performance-enhancing drugs. Scores on the Cheating/Unfairness, Motivation

and Safety subscales differentiated users and nonusers of drugs for cognitive enhancement. As in Study 1, when all participants were included in the analyses, statistically significant correlations were found between participants' scores on the four subscales and the amount they were willing to spend per month on a safe and effective cognitive enhancing drug.

In Study 3 the revised 42-item ATPCE Scale was administered twice to another independent sample of undergraduate students with a minimum of 3 weeks between Time 1 and Time 2. Test-retest reliability was good for the Cheating/Unfairness, Motivation and Safety subscales with correlations greater than .70 between participants' scores at Time 1 and Time 2, but weaker for the Expected Benefits subscale (.69). The internal consistencies of the Cheating/Unfairness, Motivation and Expected Benefits subscales were good in all three studies with Cronbach's alpha values above .80. The internal consistency of the Safety subscale was low in Study 1 ($\alpha = .63$), but adequate in Studies 2 and 3 with Cronbach's alpha values of .70 and .74 respectively.

Although not the primary focus of this project, prevalence data on the nonmedical use of prescription drugs for cognitive enhancement was collected in each of the studies. Lifetime prevalence was low in all three studies: 4.73% in Study 1, 4.31% in Study 2, and 3.85% at Time 1 in Study 3. These rates were lower than any of the lifetime prevalence rates (8 to 43%) of nonmedical use of prescription stimulants among university and college students reported in the 30 studies reviewed by Benson et al. (2015). Sabbe et al. (2022), however, reported a similar lifetime prevalence rate of 4.5% among French-speaking university students in Belgium.

Strengths and Limitations

This project had a number of strengths and limitations. In terms of strengths no previous measures to assess public attitudes toward pharmacological cognitive enhancement have been published that provide evidence of their reliability and validity. Some evidence was found for the reliability and validity of the revised 42-item ATPCE Scale. The finding of good internal consistency for the Cheating/Unfairness, Motivation, and Expected Benefits subscales and adequate internal consistency for the Safety subscale was generally replicated across the three studies. Using two different estimators and multiple fit indices, the confirmatory factor analyses provided evidence for the reliability of the four-component structure of the revised ATPCE Scale. Good test-retest reliability was found for the Cheating/Unfairness, Motivation and Safety subscales over a mimimum 3-week interval. For each of the ATPCE subscales, multiple analyses were used to investigate construct validity. Statistically significant associations were found between scores on the ATPCE subscales and most of the other constructs they were expected to be related to. Scores on the each of the four ATPCE subscales differentiated users and nonusers in Study 1 and this finding was replicated in Study 2 for the Cheating/Unfairness, Motivation and Safety subscales.

In terms of limitations, the samples used were convenience samples of Trent University undergraduate students taking Psychology courses in Peterborough and Oshawa (both located in Ontario, Canada). The composition of the samples limits the generalizability of the results. In all three studies most of the participants were female, Caucasian, and in their first or second year of university. Researchers have found that males are more likely to be nonmedical users of prescription drugs for cognitive

enhancement than females (Champagne et al., 2019; Dietz et al., 2013; Lucke et al., 2018), so males and females may differ in their attitudes about nonmedical use. Students of different ethnicities, in different programs, or at different points in their academic careers may also differ in their attitudes. Also in each of the studies most of the participants had never used a prescription or over-the-counter drug for cognitive enhancement purposes and nearly 50% indicated they were not interested in taking a drug to improve their cognitive abilities. Nonmedical users and nonusers tend to differ in their attitudes toward nonmedical use. The findings might not generalize to populations with higher prevalence rates of nonmedical use or greater willingness to use drugs for cognitive enhancement.

Another limitation is that the 42-item revised ATPCE Scale does not measure all aspects of attitudes toward pharmacological cognitive enhancement. Although the original 90 ATPCE Scale items were designed to measure attitudes in seven different areas (Cheating/Fairness, Motivation, Expected Benefits, Safety/Trust, Distributive Justice, Authenticity/Natural, and Coercion), no Distributive Justice, Authenticity/Natural or Coercion subscales emerged from the principal components analysis in Study 1. Although a few items from these three proposed subscales loaded onto the Cheating/Unfairness, Motivation, Expected Benefits and Safety subscales, most of the items that were designed to measure attitudes about who would or should have access to cognitive enhancing drugs, whether taking cognitive enhancing drugs would affect self-identity, the meaning of achievement or naturalness, and whether individuals should be forced to take cognitive ehancing drugs or would feel pressure to take them, were

dropped. It is possible that if the original 90 ATPCE Scale items were administered to more diverse samples, some of these additional subscales might be retained.

Future Directions

The revised 42-item ATPCE Scale is a new measure and needs to be administered to more diverse samples of undergraduate students to further investigate its reliability and validity. The scale was developed using undergraduate samples from only one Canadian university (two campuses) and it is unclear if the factor structure and reliability and validity findings will generalize to other undergraduate populations in Canada, the United States, or other countries. The reliability and validity of the scale should also be tested with other demographic groups (e.g., working adults). Not much is known about the attitudes of working adults toward the nonmedical use of prescription drugs for cognitive enhancement and a valid and reliable scale to measure attitudes would be a useful tool in developing knowledge in this area.

Longitudinal research should be conducted to determine the predictive validity of the revised 42-item ATPCE Scale. It is important to know if scores on the revised ATPCE Scale can predict future nonmedical use of prescription drugs for cognitive enhancement. If the scale has predictive validity, than it could be used as a tool to identify individuals who are most at risk of becoming nonmedical users and who might benefit from interventions that would challenge their beliefs about the effectiveness and safety of using prescription drugs to try to improve their cognitive functioning.

Conclusion

In conclusion, the 42-item Attitudes Toward Pharmacological Cognitive Enhancement Scale is a new measure for investigating public attitudes toward healthy

people using prescription drugs to improve their cognitive functioning. Some evidence has been provided for the internal consistency, test-retest reliability and construct validity of the ATPCE Scale. More research is needed to further assess the reliability and validity of the scale in measuring attitudes in undergraduate students and in other populations such as working adults.

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Appendix A – Study 1 ATPCE Scale

Attitudes Toward Pharmacological Cognitive Enhancement Scale

Part 1. Before we get started we would like for you to tell us a bit about yourself. Please remember that all information on this scale will be kept confidential.

1. Age: _____ yrs

2. Gender: M / F

3. Year of university:
___ 1st year
___ 2nd year
___ 3rd year
___ 4th year
___ 5th year and beyond

4. Do you currently live:
___ at home with your family
___ on campus
___ away from home, with roommate(s)
___ away from home, with romantic partner
___ away from home on your own

5. Current employment status:
___ I am working full-time
___ I am working part-time
___ I am currently not working

6. Household income level:
___ Under $10,000
___ $10,000 to 19,000
___ $20,000 to 29,000
___ $30,000 to 39,000
___ $40,000 to 49,000
___ $50,000 to 59,000
___ $60,000 to 69,000
___ $70,000 to 79,0000
___ $80,000 to 89,0000
___ $90,000 to 99,000
___ Over $100,000

7. Ethnicity:
___ Caucasian/White
___ Indigenous/First Nations
___ African/Black
___ Asian/Pacific Islander
___ Hispanic/Latino

___ Other (please specify: _____)

8. Have you ever taken a prescription drug (e.g., Ritalin, Adderall, Modafinil) or an over-the-counter drug (e.g., Ginkgo biloba, Ginseng) specifically with the intent to enhance your cognitive functioning (e.g., memory, attention/concentration, problem-solving, etc.)?

   Yes / No

   If yes, please list the drug(s):

   _____

   [For *each* drug listed, participants will be asked to complete the following:]

   Have you taken it in the past year? Yes / No

   If yes, how often did you take the drug(s)?
   ___ Daily
   ___ Once a week
   ___ Once a month
   ___ Less than once a month

   Where did you receive the drug?
   ___ A doctor prescribed it to me
   ___ A friend
   ___ A pharmacy
   ___ A health food store
   ___ Parent gave it to me
   ___Took from a family prescription
   ___ The internet
   ___ Other: _____

   Was the drug effective in enhancing your cognition? Yes / No

   Did you experience any unpleasant side effects? Yes / No

   If yes, please describe: _____

Part 2. We are interested in learning about your attitudes toward pharmacological cognitive enhancement. *More specifically, we would like to know how you feel about healthy individuals using drugs to enhance their cognitive abilities.*

By ***healthy***, we mean those individuals who do not have any cognitive disorders or learning disabilities such as Alzheimer's disease, attention deficit disorder, etc.

By ***drugs***, we mean current or future prescription drugs that can be obtained legally from a doctor. We are not referring to substances such as caffeine or illegal street drugs.

By ***cognitive abilities***, we mean the ability to remember, pay attention, solve problems, etc.

Please indicate how strongly you agree or disagree with each of the statements below, using the following scale:

Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Moderately Agree	Strongly Agree

1. Drugs prescribed to enhance cognition are effective.
2. I take over the counter and/or prescription drugs of any kind only when I have to.
3. The use of cognitive enhancing drugs by healthy adults is a form of cheating.
4. Taking a drug to enhance my cognitive abilities would change who I am as a person.
5. Access to cognitive enhancing drugs should be limited to those in need.
6. Cognitive enhancing drugs will help students do better in school.
7. I would not take a cognitive enhancing drug even if others around me were taking it.
8. Drugs that are currently used to enhance cognition are relatively safe.
9. Drugs sold in health food stores (e.g., Ginkgo biloba) are effective at enhancing cognition.
10. I often think about taking a drug to enhance my cognitive abilities.
11. It is fair for healthy people to take a cognitive enhancing drug.
12. The benefits of cognitive enhancement are worth the risks.
13. My sense of identity would not be affected if I took a cognitive enhancing drug.
14. Older adults should have greater access to cognitive enhancing drugs than young adults.
15. In the future, parents might feel pressure to give their children cognitive enhancing drugs.

16. Doctors would not prescribe cognitive enhancing drugs to their patients if they were not safe.
17. In the future, cognitive enhancing drugs will be more effective than they are today.
18. I would take a cognitive enhancing drug if it were safe and effective.
19. I would not feel guilty if I performed really well on a test after taking a cognitive enhancing drug.
20. It would be unnatural to enhance our cognitive abilities with a drug.
21. People should be free to use whatever means they can to enhance their cognitive abilities.
22. People can make their own decisions whether they want to use cognitive enhancing drugs.
23. The government would not allow healthy people to purchase cognitive enhancing drugs if they were not safe.
24. Cognitive enhancing drugs improve the quality of life.
25. I would take a cognitive enhancing drug even if it were illegal for me to do so.
26. People should tell their boss if they know someone is taking a cognitive enhancing drug at work.
27. People should enhance their cognitive abilities by working harder, not by taking a drug.
28. Companies that make cognitive enhancing drugs will benefit more than the people taking these drugs.
29. Healthy adults should not be allowed to use cognitive enhancing drugs because they do not need them to function.
30. If you are reading this question, please check ‘Agree’.
31. The pressure of knowing others take cognitive enhancing drugs would make it hard to resist taking them.
32. If the government approves a cognitive enhancing drug, it means the long-term risks of taking it are known.
33. In the future, cognitive enhancing drugs will improve the quality of people’s lives.
34. I would not take a cognitive enhancing drug, even if it were free.
35. People should tell their teacher if they know someone is taking a cognitive enhancing drug at school.
36. Taking a cognitive enhancing drug would help people to become whom they truly are.
37. Wealthy people will have greater access to cognitive enhancing drugs.

38. In the future, students will need to take cognitive enhancing drugs to get into a good school.
39. Even if my doctor advised against it, I would try a cognitive enhancing drug if my close friends were using it.
40. There is little benefit gained from using cognitive enhancing drugs.
41. I would try a cognitive enhancing drug even if there were a risk of some mild side effects.
42. Taking a drug to enhance one's cognitive abilities is just as fair as paying for a tutor.
43. People would feel less good about themselves if they took a drug to improve their cognitive abilities.
44. Cognitive enhancing drugs will help everyone to reach their full potential.
45. People in certain careers should be required to use cognitive enhancing drugs. Some example careers include airline pilots, surgeons, etc.
46. I would be concerned about the safety of taking a cognitive enhancing drug.
47. Most people are already functioning at their cognitive peak, so there is little room left for improvement.
48. I would try a cognitive enhancing drug even if there were a risk of some moderate side effects.
49. Like steroid use in sports competitions, taking cognitive enhancing drugs in school is unfair.
50. Some people are naturally smarter than others. Cognitive enhancing drugs would help to reduce these natural differences.
51. Schools should provide cognitive enhancing drugs to all students.
52. Cognitive enhancing drugs will help people to get good jobs.
53. I would take a cognitive enhancing drug if all of my friends took it.
54. There may be long-term risks and side effects of taking a cognitive enhancing drug.
55. Smart people will not benefit from cognitive enhancing drugs.
56. I would try a cognitive enhancing drug even if there were a risk of some serious side effects.
57. It is the role of the government to discourage the use of cognitive enhancing drugs by healthy adults.
58. People should take less credit for work done under the influence of a cognitive enhancing drug.
59. People should not be prevented from taking cognitive enhancing drugs because some might be opposed to their use.

60. If you are reading this, please check ‘Strongly Disagree’.
61. We should expect better work from someone who uses a cognitive enhancing drug.
62. People who take cognitive enhancing drugs may become addicted to them.
63. The benefits from cognitive enhancing drugs in the future will outweigh their financial cost.
64. I would take a cognitive enhancing drug only when I really needed to. For example, to study, stay alert, to meet a deadline at work, or to focus intently.
65. Students who use cognitive enhancing drugs should be punished.
66. People who choose to use cognitive enhancing drugs will not be any happier than those who choose not to use them.
67. The use of cognitive enhancing drugs will deprive people of opportunities to learn from their mistakes.
68. Only people who score poorly on cognitive tests should have access to cognitive enhancing drugs.
69. People taking a cognitive enhancing drug would be expected to work shorter hours to achieve the same result.
70. People who take cognitive enhancing drugs may require larger doses to achieve the same effect.
71. Societies that encourage the use of cognitive enhancing drugs will be more innovative than societies that do not.
72. I would take a cognitive enhancing drug every day, even if I did not really need to.
73. Employees who use cognitive enhancing drugs should be rewarded.
74. I would not think less of a friend if he or she started using a cognitive enhancing drug.
75. Everyone should be allowed to use cognitive enhancing drugs.
76. Access to cognitive enhancing drugs might make us more competitive.
77. Taking a cognitive enhancing drug may lead to abuse of drugs in general.
78. Cognitive enhancing drugs will improve our ability to remember.
79. I would take a cognitive enhancing drug in order to do better at school or work.
80. Parents should not allow their children to use cognitive enhancing drugs because it is a form of cheating.
81. If I used a cognitive enhancing drug, I would keep it a secret from my friends and family.
82. Everyone should be allowed to use cognitive enhancing drugs, even those who are very smart.
83. We do not know enough about the brain to safely develop cognitive enhancing drugs.

84. Cognitive enhancing drugs will make it easier to concentrate.
85. I would take a cognitive enhancing drug because the achievements might benefit society.
86. People who take cognitive enhancing drugs at work should be paid less.
87. The fact that we never really know the long-term safety of drugs would persuade me from taking a cognitive enhancing drug.
88. Cognitive enhancing drugs will make people smarter.
89. I would take a drug now to reduce my risk of developing cognitive problems when I get older.
90. Cognitive enhancing drugs should not be used because people should be accepted for who they are.
91. Cognitive enhancing drugs will allow us to perform tasks more quickly.
92. I would not take a cognitive enhancing drug because I do not need to.
93. If a safe and effective drug existed that could enhance your cognitive abilities, what benefits would you expect to gain from this drug?

_____

_____

94. If a safe and effective drug existed that could enhance your cognitive abilities, how much money would you be willing to pay per month to use this drug:

___ I am not interested in taking a drug to enhance my cognitive abilities

___ $0 to $9 per month

___ $10 to $19 per month

___ $20 to $29 per month

___ $30 to $39 per month

___ $40 to $49 per month

___ $50 to $59 per month

___ $60 to 69 per month

___ $70 to $79 per month

___ $80 to $89 per month

___ $90 to $99 per month

___ $100 or more per month

Scoring Key

Assign the following scores to the items:

SD=1, MD=2, D=3, N=4, A=5, MS=6, SA=7 (n=64 items)		**SD=7, MD=6, D=5, N=4, A=3, MS=2, SA=1 (n=26 items)**	
1	63	2	
3	64	5	
4	65	7	
6	67	8	
9	69	11	
10	70	13	
12	71	14	
15	72	16	
17	75	19	
18	76	22	
20	77	23	
21	78	28	
24	79	29	
25	80	32	
26	81	34	
27	82	37	
31	83	39	
33	84	40	
35	85	42	
36	86	47	
38	87	55	
41	88	66	
43	89	68	
44	90	73	
45	91	74	
46		92	
48			
49			
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52			
53			
54			
56			
57			
58			
59			
61			
62			

Group the items into the following subscales

EXPECTED BENEFITS [EB]

- **Low scores = Low expectations of benefits from cognitive enhancing (CE) drugs**
- **High scores = High expectations of benefit from CE drugs**
- 19 Items:
    - 1, 6, 9, 12, 17, 24, 28, 33, 40, 47, 52, 55, 63, 66, 71, 78, 84, 88, and 91

MOTIVATION [M]

- **Low scores = Low motivation to use CE drugs**
- **High scores = High motivation to use CE drugs**
- 14 Items:
    - 2, 10, 18, 25, 34, 41, 48, 56, 64, 72, 79, 85, 89, and 92

CHEATING/FAIRNESS [CF]

- **Low scores = Use of CE drugs is NOT cheating/unfair**
- **High scores = Use of CE drugs is cheating/unfair**
- 11 items:
    - 3, 11, 19, 26, 35, 42, 49, 57, 65, 73, and 80

AUTHENTICITY/NATURAL

- **Low scores = Drugs would NOT affect our authenticity**
- **High scores = Drugs would affect our authenticity (positively or negatively)**
- 13 items:
    - 4, 13, 20, 27, 36, 43, 50, 58, 67, 74, 81, 86, and 90

DISTRIBUTIVE JUSTICE

- **Low scores = Access should/would be limited**
- **High scores = Equal access should/would be available to everyone**
- 11 items:
    - 5, 14, 21, 29, 37, 44, 51, 59, 68, 75, and 82

COERCION (SOCIAL/PEER PRESSURE)

- **Low scores = There would be NO coercion to use CE drugs**
- **High scores = There would be coercion to use CE drugs**
- 10 items:
    - 7, 15, 22, 31, 38, 45, 53, 61, 69, and 76

SAFETY/TRUST

- **Low scores = Little concern about safety of CE drugs**
- **High scores = Concern about safety of CE drugs**
- 12 items:
    - 8, 16, 23, 32, 39, 46, 54, 62, 70, 77, 83, and 87

Appendix B – Study 1 Consent Form

DEPARTMENT OF PSYCHOLOGY

1600 West Bank Drive
Peterborough, ON Canada K9J 7B8
Telephone: (705) 748-1011 x7535
Facsimile: (705) 748-1580
www.trent.ca/psychology
Email: psychology@trentu.ca

Informed Consent Form

Study Title:	Attitudes Toward Pharmacological Cognitive Enhancement
Faculty Investigator:	Dr. Kevin Peters, Department of Psychology, Trent University Email: kevinpeters@trentu.ca; Phone: (705) 748-1011 est.7795
Student Investigator:	Ms. Heather Patton, Department of Psychology, Trent University, Email: heatherpatton@trentu.ca

The purpose of this study is to examine people's attitudes toward pharmacological cognitive enhancement. In other words, how do people feel about individuals taking a drug to enhance their cognitive abilities (e.g., to remember more). This study is the first step in developing a scale that we can use in the future to better assess people's attitudes on this subject. Note: you will not be asked to use any drugs in this study, but rather, you will simply be asked to indicate how willing you would be to do so as well as your attitudes about such behaviour. Participants will be asked to complete four online scales; if you agree to participate in this study you will be sent to an external website (Qualtrics via Trent University) to fill out of the scales. This study should take approximately 60 minutes to complete.

Students enrolled in PSYC 1020H, 1030H, 2016H, and 2017H will receive 1.0 bonus research credit for participating in this study. In terms of other benefits, students will also gain valuable experience of what it is like to be a participant in a research study. In addition, by participating in this study, students will be helping the researchers gain a better understanding of the issues related to the use of drugs to enhance various psychological and physical characteristics.

The researchers do not have any conflicts of interest to declare about this study, and there will be no commercialization from the results of this study.

I understand that the risks associated with being involved in this research are only minimal. I also understand that I am not required to answer any questions I do not wish to, and that I can withdraw from the study at any time.

I understand that my responses to the scale items will form the data for this study. I also understand that these data will be used in research publications, student theses or projects, or for teaching purposes and that the names and any identifying information of individual participants will not be made public - results are only considered in terms of group performance and not individuals. I understand that my personal information will not be directly attached to any of the responses that I provide to the questions. I also understand that my responses will be saved temporarily on the Qualtrics webserver and that they will be downloaded by one of the investigators and securely saved on one a computer (which will also be encrypted). I understand that personal information and all data needed to assign bonus credit for participating will be stored in a secure place accessible only to the investigators and that these data will be destroyed after the bonus credit has been assigned. All electronic data from the scale will be destroyed seven years after publication of the research.

I understand that this project has been reviewed and received ethics approval from the Trent University Research Ethics Board.

I understand the purpose of this research and the requirements and risks, if any, which are placed on me as explained by the investigator. I have received a copy of this consent form.

I, the undersigned, willingly consent to participate in this study.

□ I agree

If you have any questions or concerns related to this research study, please feel free to contact Karen Mauro, the Compliance Officer of the Trent University Research Ethics Board by email (kmauro@trentu.ca) or phone (705-748-1011 x.7050).

Appendix C – Study 1 Participant Debriefing Form

DEPARTMENT OF PSYCHOLOGY
1600 West Bank Drive
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Telephone: (705) 748-1011 x7535
Facsimile: (705) 748-1580
www.trent.ca/psychology
Email: psychology@trentu.ca

Participant Debriefing Form

Study Title: Attitudes Toward Pharmacological Cognitive Enhancement

Faculty Investigator: Dr. Kevin Peters, Department of Psychology, Trent University
Email: kevinpeters@trentu.ca; Phone: (705) 748-1011 est.7795

Student Investigator: Ms. Heather Patton, Department of Psychology, Trent University, Email: heatherpatton@trentu.ca

Thank you very much for participating in our study! You have played a crucial role in the advancement of research in this area. Your time and effort are greatly appreciated.

Here is a little more information about the study you just completed. There is growing debate over the nonmedical use of prescription drugs by 'healthy' individuals (i.e., individuals without medical diagnoses related to the drug in question). For example, studies have reported that anywhere between 6.9% to 55% of college students have used stimulants (e.g., Ritalin) to help them study or to stay awake longer (DeSantis, Noar, & Webb, 2009). Regardless of whether one is for or against the nonmedical use of drugs for enhancement purposes, most agree that there needs to be wider societal engagement and debate on these issues.

The purpose of this study is to examine people's attitudes about the use of a safe and effective drug for enhancing cognitive abilities (e.g., the ability to remember). Please note that although there currently are no such drugs

available for healthy people (i.e., those without a medical diagnosis), this situation may change in the future. This study is the first step in developing a scale that we, and other researchers, will be able to use to assess these kinds of attitudes in a more objective and reliable way. We also collected data from other scales that we feel might be important in explaining why some people might express favourable or unfavourable attitudes toward cognitive enhancement.

We expect that we should be finished collecting and analyzing data by the end of the Winter 2014 semester; if you would like a copy of our results or any subsequent publications please feel free to send one of the researchers an email to make such a request.

If you have any questions or concerns related to this research study, please feel free to contact Karen Mauro, the Compliance Officer of the Trent University Research Ethics Board by email (kmauro@trentu.ca) or phone (705-748-1011 x.7050).

If you find that, for whatever reason, you experience any lasting adverse emotional effects in the coming days after completing this experiment, we encourage you to seek counselling from one of the following services:

Trent University Counselling Centre (students only)	705-748-1386 Blackburn Hall, Suite 113
Four Counties Crisis Hotline	705-745-6484 866-995-9933

Appendix D – Study 2 Demographics Questionnaire

Demographics Questionnaire

Before we get started we would like for you to tell us a bit about yourself. Please remember that all information on this questionnaire will be kept confidential.

1. Age: _____ yrs

2. Gender: M / F

3. Year of university:
___ 1st year
___ 2nd year
___ 3rd year
___ 4th year
___ 5th year and beyond

4. Do you currently live:
___ at home with your family
___ on campus
___ away from home, with roommate(s)
___ away from home, with romantic partner
___ away from home on your own

5. Current employment status:
___ I am working full-time
___ I am working part-time
___ I am currently not working

6. Household income level:
___ Under $10,000
___ $10,000 to 19,000
___ $20,000 to 29,000
___ $30,000 to 39,000
___ $40,000 to 49,000
___ $50,000 to 59,000
___ $60,000 to 69,000
___ $70,000 to 79,0000
___ $80,000 to 89,0000
___ $90,000 to 99,000
___ Over $100,000

7. Ethnicity:
___ Caucasian/White
___ Indigenous/First Nations
___ African/Black
___ Asian/Pacific Islander

___ Hispanic/Latino
___ Other (please specify: _____)

8. How would you rate your current cognitive abilities (e.g., memory, attention/concentration, problem-solving, etc.)?
___ Well below average
___ Below average
___ Average
___ Above average
___ Well above average

9. How satisfied are you with your current ability to pay attention?
___ Very dissatisfied
___ Moderately dissatisfied
___ Slightly dissatisfied
___ Neither dissatisfied nor satisfied
___ Slightly satisfied
___ Moderately satisfied
___ Very satisfied

10. How satisfied are you with your current ability to remember?
___ Very dissatisfied
___ Moderately dissatisfied
___ Slightly dissatisfied
___ Neither dissatisfied nor satisfied
___ Slightly satisfied
___ Moderately satisfied
___ Very satisfied

11. How satisfied are you with you current academic performance?
___ Very dissatisfied
___ Moderately dissatisfied
___ Slightly dissatisfied
___ Neither dissatisfied nor satisfied
___ Slightly satisfied
___ Moderately satisfied
___ Very satisfied

12. Have you ever taken a prescription drug (e.g., Ritalin, Adderall, Modafinil) specifically with the intent to enhance your cognitive functioning (e.g., memory, attention/ concentration, problem-solving, etc.)?
Yes / No

If yes, please list the drug(s):_____

[For *each* drug listed, participants will be asked to complete the following:]

Have you taken it in the past year? Yes / No

If yes, how often did you take the drug(s)?
___ Daily
___ Once a week
___ Once a month
___ Less than once a month

Where did you receive the drug?
___ A doctor prescribed it to me
___ A friend
___ A pharmacy
___ A health food store
___ Parent gave it to me
___Took from a family prescription
___ The internet
___ Other: _____

Was the drug effective in enhancing your cognition? Yes / No

Did you experience any unpleasant side effects? Yes / No

If yes, please describe: _____

13. Have you ever taken an over-the-counter drug (e.g., e.g., Ginkgo biloba, Ginseng) specifically with the intent to enhance your cognitive functioning (e.g., memory, attention/concentration, problem-solving, etc.)?
Yes / No

If yes, please list the drug(s): _____

[For *each* drug listed, participants will be asked to complete the following:]

Have you taken it in the past year? Yes / No

If yes, how often did you take the drug(s)?
___ Daily
___ Once a week
___ Once a month
___ Less than once a month

Where did you receive the drug?

___ A friend
___ A pharmacy
___ A health food store
___ Parent gave it to me
___ The internet
___ Other: _____

Was the drug effective in enhancing your cognition? Yes / No

Did you experience any unpleasant side effects? Yes / No

If yes, please describe: _____

Appendix E – Study 2 Revised ATPCE Scale

Attitudes Toward Pharmacological Cognitive Enhancement Scale

We are interested in learning about your attitudes toward pharmacological cognitive enhancement. *More specifically, we would like to know how you feel about healthy individuals using drugs to enhance their cognitive abilities.*

By ***healthy***, we mean those individuals who do not have any cognitive disorders or learning disabilities such as Alzheimer's disease, attention deficit disorder, etc.

By ***drugs***, we mean current or future prescription drugs that can be obtained legally from a doctor. We are not referring to substances such as caffeine or illegal street drugs.

By ***cognitive abilities***, we mean the ability to remember, pay attention, solve problems, etc.

Please indicate how strongly you agree or disagree with each of the statements below, using the following scale:

Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Moderately Agree	Strongly Agree

1. The use of cognitive enhancing drugs by healthy adults is a form of cheating.

2. I would not take a cognitive enhancing drug even if others around me were taking it.

3. Cognitive enhancing drugs will help people to get good jobs.

4. Everyone should be allowed to use cognitive enhancing drugs, even those who are very smart.

5. I often think about taking a drug to enhance my cognitive abilities.

6. People should take less credit for work done under the influence of a cognitive enhancing drug.

7. Cognitive enhancing drugs improve the quality of life.

8. It is the role of the government to discourage the use of cognitive enhancing drugs by healthy adults.

9. I would be concerned about the safety of taking a cognitive enhancing drug.

10. It is fair for healthy people to take a cognitive enhancing drug.

11. Some people are naturally smarter than others. Cognitive enhancing drugs would help to reduce these natural differences.

12. I would take a cognitive enhancing drug if all of my friends took it.

13. People should tell their teacher if they know someone is taking a cognitive enhancing drug at school.

14. Societies that encourage the use of cognitive enhancing drugs will be more innovative than societies that do not.

15. The use of cognitive enhancing drugs will deprive people of opportunities to learn from their mistakes.

16. I would try a cognitive enhancing drug even if there were a risk of some mild side effects.

17. Access to cognitive enhancing drugs should be limited to those in need.

18. We do not know enough about the brain to safely develop cognitive enhancing drugs.

19. Like steroid use in sports competitions, taking cognitive enhancing drugs in school is unfair.

20. If you are reading this, please check 'Strongly Agree'.

21. I would not take a cognitive enhancing drug, even if it were free.

22. Cognitive enhancing drugs will allow us to perform tasks more quickly.

23. People can make their own decisions whether they want to use cognitive enhancing drugs.

24. I would take a cognitive enhancing drug in order to do better at school or work.

25. People should tell their boss if they know someone is taking a cognitive enhancing drug at work.

26. Cognitive enhancing drugs will make people smarter.

27. Taking a drug to enhance my cognitive abilities would change who I am as a person.

28. The fact that we never really know the long-term safety of drugs would persuade me from taking a cognitive enhancing drug.

29. Everyone should be allowed to use cognitive enhancing drugs.

30. In the future, cognitive enhancing drugs will improve the quality of people's lives.

31. I would take a cognitive enhancing drug only when I really needed to. For example, to study, stay alert, to meet a deadline at work, or to focus intently.

32. Parents should not allow their children to use cognitive enhancing drugs because it is a form of cheating.

33. Cognitive enhancing drugs will help students do better in school.

34. I would not think less of a friend if he or she started using a cognitive enhancing drug.

35. I would take a cognitive enhancing drug if it were safe and effective.

36. Healthy adults should not be allowed to use cognitive enhancing drugs because they do not need them to function.

37. There may be long-term risks and side effects of taking a cognitive enhancing drug.

38. People who take cognitive enhancing drugs at work should be paid less.

39. I would not take a cognitive enhancing drug because I do not need to.

40. If you are reading this, please check 'Strongly Disagree'.

41. Cognitive enhancing drugs will improve our ability to remember.

42. People should be free to use whatever means they can to enhance their cognitive abilities.

43. I would try a cognitive enhancing drug even if there were a risk of some moderate side effects.

44. Students who use cognitive enhancing drugs should be punished.

45. If a safe and effective drug existed that could enhance your cognitive abilities, what benefits would you expect to gain from this drug?

_____

_____

46. If a safe and effective drug existed that could enhance your cognitive abilities, how much money would you be willing to pay per month to use this drug:

___ I am not interested in taking a drug to enhance my cognitive abilities
___ $0 to $9 per month
___ $10 to $19 per month
___ $20 to $29 per month
___ $30 to $39 per month
___ $40 to $49 per month
___ $50 to $59 per month
___ $60 to 69 per month
___ $70 to $79 per month
___ $80 to $89 per month
___ $90 to $99 per month
___ $100 or more per month

Scoring Key

Assign the following scores to the items:

SD=1, MD=2, D=3, N=4, A=5, MS=6, SA=7 (n=33 items)	**SD=7, MD=6, D=5, N=4, A=3, MS=2, SA=1 (n=9 items)**
1	2
3	4
5	10
6	21
7	23
8	29
9	34
11	39
12	42
13	
14	
15	
16	
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41	
43	
44	

Group the items into the following subscales

CHEATING/UNFAIRNESS

- **Low scores = Use of cognitive enhancing (CE) drugs is NOT cheating/unfair**
- **High scores = Use of CE drugs is cheating/unfair**
- 19 items:
    - 1, 4, 6, 8, 10, 13, 15, 17, 19, 23, 25, 27, 29, 32, 34, 36, 38, 42, and 44

MOTIVATION

- **Low scores = Low motivation to use CE drugs**
- **High scores = High motivation to use CE drugs**
- 10 Items:
    - 2, 5, 12, 16, 21, 24, 31, 35, 39, and 43

EXPECTED BENEFITS

- **Low scores = Low expectations of benefits from CE drugs**
- **High scores = High expectations of benefits from CE drugs**
- 9 Items:
    - 3, 7, 11, 14, 22, 26, 30, 33, and 41

SAFETY

- **Low scores = Little concern about safety of CE drugs**
- **High scores = Concern about safety of CE drugs**
- 4 items:
    - 9, 18, 28, and 37

Appendix F – Study 2 SONA Script for Recruiting Participants

The purpose of this study is to gain a better understanding of people's attitudes toward using drugs to enhance their cognitive abilities (e.g. ability to remember, pay attention, solve problems). This is an online study. You will be asked to complete several questionnaires. The study should take approximately 60 minutes to complete. If you sign up for the study, you will be directed to an external website (Qualtrics). Please read the Informed Consent form there, and if you are interested in participating, click on the "I agree" button.

Appendix G – Study 2 Consent Form

DEPARTMENT OF PSYCHOLOGY
1600 West Bank Drive
Peterborough, ON Canada K9J 7B8
Telephone: (705) 748-1011 x7535
Facsimile: (705) 748-1580
www.trent.ca/psychology
Email: psychology@trentu.ca

Informed Consent Form

Study Title: Attitudes Toward Cognitive Enhancement

Student Investigator: Ms. Heather Patton, Department of Psychology, Trent University, Email: heatherpatton@trentu.ca

Faculty Investigator: Dr. Kevin Peters, Department of Psychology, Trent University
Email: kevinpeters@trentu.ca; Phone: (705) 748-1011 est.7795

The purpose of this study is to examine people's attitudes toward pharmacological cognitive enhancement. In other words, how do people feel about individuals taking a drug to enhance their cognitive abilities (e.g., to remember more).
This study is part of a larger project to develop a scale that we can use in the future to better assess people's attitudes on this subject. Note: you will not be asked to use any drugs in this study, but rather, you will simply be asked to indicate how willing you would be to do so as well as your attitudes about such behaviour. Participants will be asked to complete several questionnaires; if you agree to participate in this study you will fill out the questionnaires on the Qualtrics Survey System (an external website accessed via Trent University's SONA System). This study should take approximately 60 minutes to complete.

Students enrolled in PSYC 1020H, 1030H, 2018H, and 2019H will receive 1.0 bonus research credit for participating in this study. In terms of other benefits, students will also gain valuable experience of what it is like to be a participant in a research study. In addition, by participating in this study, students will be helping the researchers gain a better understanding of the issues related

to the use of drugs to enhance various psychological and physical characteristics.

The researchers do not have any conflicts of interest to declare about this study, and there will be no commercialization from the results of this study.

I understand that the risks associated with being involved in this research are only minimal. I also understand that I am not required to answer any questions I do not wish to, and that I can withdraw from the study at any time.

I understand that my responses to the scale items will form the data for this study. I also understand that these data will be used in research publications, student theses or projects, or for teaching purposes and that the names and any identifying information of individual participants will not be made public - results are only considered in terms of group performance and not individuals. I understand that my personal information will not be directly attached to any of the responses that I provide to the questions. I also understand that my responses will be saved temporarily on the Qualtrics webserver and that they will be downloaded by one of the investigators and securely saved on one computer (which will also be encrypted). I understand that personal information and all data needed to assign bonus credit for participating will be stored in a secure place accessible only to the investigators and that these data will be destroyed after the bonus credit has been assigned. All electronic data from the questionnaires will be destroyed seven years after publication of the research.

I understand that this project has been reviewed and received ethics approval from the Trent University Research Ethics Board.

I understand the purpose of this research and the requirements and risks, if any, which are placed on me as explained by the investigator. I have received a copy of this consent form.

I, the undersigned, willingly consent to participate in this study.

☐ I agree

If you have any questions or concerns related to this research study, please feel free to contact Karen Mauro, the Compliance Officer of the Trent University Research Ethics Board by email (kmauro@trentu.ca) or phone (705-748-1011 x.7050).

Appendix H – Study 2 Order of Questionnaires

Order of Questionnaires

	Position of Questionnaire							
Order	**1st**	**2st**	**3rd**	**4th**	**5th**	**6th**	**7th**	**8th**
1	DEMO	ATPCE	PEAS	PSEQ-II	EPQ	PSS	POS	BIDR
2	DEMO	PEAS	EPQ	ATPCE	POS	PSEQ-II	PSS	BIDR
3	DEMO	EPQ	POS	PEAS	PSS	ATPCE	PSEQ-II	BIDR
4	DEMO	POS	PSS	EPQ	PSEQ-II	PEAS	ATPCE	BIDR
5	DEMO	PSS	PSEQ-II	POS	ATPCE	EPQ	PEAS	BIDR
6	DEMO	PSEQ-II	ATPCE	PSS	PEAS	POS	EPQ	BIDR

DEMO = Demographics Questionnaire
ATPCE = Attitudes Towards Pharmacological Cognitive Enhancement
PEAS = Performance Enhancement Attitude Scale
PSEQ-II = Prescription Stimulant Expectancy Questionnaire-Version 2
EPQ = Ethics Position Questionnaire
PSS = Perceived Stress Scale
POS = Pharmacological Optimism Scale
BIDR = Balanced Inventory of Desirable Responding

Appendix I – Study 2 Participant Debriefing Form

DEPARTMENT OF PSYCHOLOGY
1600 West Bank Drive
Peterborough, ON Canada K9J 7B8
Telephone: (705) 748-1011 x7535
Facsimile: (705) 748-1580
www.trent.ca/psychology
Email: psychology@trentu.ca

Participant Debriefing Form

Study Title: Attitudes Toward Cognitive Enhancement

Student Investigator: Ms. Heather Patton, Department of Psychology, Trent University, Email: heatherpatton@trentu.ca

Faculty Investigator: Dr. Kevin Peters, Department of Psychology, Trent University, Email: kevinpeters@trentu.ca; Phone: (705) 748-1011 est.7795

Thank you very much for participating in our study! You have played a crucial role in the advancement of research in this area. Your time and effort are greatly appreciated.

Here is a little more information about the study you just completed. There is growing debate over the nonmedical use of prescription drugs by 'healthy' individuals (i.e., individuals without medical diagnoses related to the drug in question). For example, studies have reported that anywhere between 6.9% to 55% of college students have used stimulants (e.g., Ritalin) to help them study or to stay awake longer (DeSantis, Noar, & Webb, 2009). Regardless of whether one is for or against the nonmedical use of drugs for enhancement purposes, most agree that there needs to be wider societal engagement and debate on these issues.

The purpose of this study is to examine people's attitudes about the use of a safe and effective drug for enhancing cognitive abilities (e.g., the ability to remember). Please note that although there currently are no such drugs available for healthy people (i.e., those without a medical diagnosis), this situation may change in the future. This study is part of a larger project to

develop a scale that we, and other researchers, will be able to use to assess these kinds of attitudes in a more objective and reliable way. We also collected data from other scales that measure constructs that we feel should be related to our scale.

We expect that we should be finished collecting and analyzing data by the end of the Winter 2016 semester; if you would like a copy of our results or any subsequent publications please feel free to send one of the researchers an email to make such a request.

If you have any questions or concerns related to this research study, please feel free to contact Karen Mauro, the Compliance Officer of the Trent University Research Ethics Board by email (kmauro@trentu.ca) or phone (705-748-1011 x.7050).

If you find that, for whatever reason, you experience any lasting adverse emotional effects in the coming days after completing this study, we encourage you to seek counselling from one of the following services:

Trent University Counselling Centre (students only)	705-748-1386 Blackburn Hall, Suite 113
Four Counties Crisis Hotline	705-745-6484 866-995-9933

Appendix J – Study 3 SONA Script for Recruiting Participants at Time 1

The purpose of this study is to gain a better understanding of people's attitudes toward using drugs to enhance their cognitive abilities (e.g., ability to remember, pay attention, solve problems). This is an online study consisting of two parts ("Attitudes Toward Cognitive Enhancement Time 1" and "Attitudes Toward Cognitive Enhancement Time 2") completed over a 3-week interval. At Time 1 you will be asked to complete two questionnaires. This should take approximately 20 minutes to complete. Participants who complete Time 1 of the study will receive 0.5 bonus course credits. Participants who complete all of Time 1 of the study and who correctly answer two questions that require a specific response will be sent an email in 3 weeks with information on signing up for and completing the second part of the study. At Time 2 you will be asked to complete one of the questionnaires from Time 1 again. It will take approximately 10 minutes to complete the questionnaire and upon completion you will receive an additional 0.25 bonus course credits. Participants who complete all of Time 1 and Time 2 of the study and who provide correct answers at Times 1 and 2 to the two questions that require a specific response will also receive a $5 Amazon eGift card that can be used to make purchases on Amazon's website. The eGift card will be sent to the email address you provided when you signed up to be a participant on SONA. It is very important that participants complete both parts of the study (Time 1 and Time 2), so please do not sign up unless you plan on completing both parts. If you sign up for the study, you will be directed to an external website (Qualtrics). Please read the Informed Consent form there, and if you are interested in participating, click on the "I agree" button.

Appendix K – Study 3 Consent Form

DEPARTMENT OF PSYCHOLOGY
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Peterborough, ON Canada K9J 7B8
Telephone: (705) 748-1011 x7535
Facsimile: (705) 748-1580
www.trent.ca/psychology
Email: psychology@trentu.ca

Informed Consent Form

Study Title:	Attitudes Toward Cognitive Enhancement Times 1 and 2
Student Investigator:	Ms. Heather Patton, Department of Psychology, Trent University, Email: heatherpatton@trentu.ca
Faculty Investigator:	Dr. Kevin Peters, Department of Psychology, Trent University, Email: kevinpeters@trentu.ca; Phone: (705) 748-1011 est.7795

This is an online study consisting of two parts ("Attitudes Toward Cognitive Enhancement Time 1" and "Attitudes Toward Cognitive Enhancement Time 2") to be completed over a 3-week interval. This study is part of a larger project to develop a scale to assess people's attitudes toward pharmacological cognitive enhancement. In other words, how do people feel about individuals taking a drug to enhance their cognitive abilities (e.g., to remember more). Note: you will not be asked to use any drugs in this study, but rather, you will simply be asked to indicate how willing you would be to do so as well as your attitudes about such behaviour. If you agree to participate, you will fill out two questionnaires (Time 1) on the Qualtrics Survey System (an external website accessed via Trent University's SONA System). Time 1 of the study should take approximately 20 minutes to complete. Three weeks after completing Time 1, you will be sent an email with information about signing up and completing Time 2 of the study. At Time 2 you will be asked to complete one of the questionnaires from Time 1 again. This will take approximately 10 minutes to complete. It is very important that participants complete both parts of the study, so please do not sign up unless you plan on completing both parts.

Students enrolled in PSYC 1020H, 1030H, 2018H, and 2019H will receive a 0.5 bonus course credit for participating in Time 1 of the study. Only participants who complete all of Time 1 of the study and who correctly answer two questions that require a specific response (e.g., If you are reading this, Please check 'Strongly Agree') will receive an email in 3 weeks time with information on signing up for

and completing Time 2 of the study. Participants who complete Time 2 of the study will receive an additional 0.25 bonus course credit. Those participants who complete all of Time 2 of the study and who correctly answer the two questions that require a specific response will also receive a $5 Amazon eGift card that can be used to make purchases on Amazon's website. The eGift card will be sent to the email address you provided when you signed up as a participant on SONA. In terms of other benefits, students will also gain valuable experience of what it is like to be a participant in a research study. In addition, by participating in this study, students will be helping the researchers gain a better understanding of the issues related to the use of drugs to enhance various psychological and physical characteristics.

The researchers do not have any conflicts of interest to declare about this study, and there will be no commercialization from the results of this study.

I understand that the risks associated with being involved in this research are only minimal. I also understand that I am not required to answer any questions I do not wish to, and that I can withdraw from the study at any time.

I understand that my responses to the scale items will form the data for this study. I also understand that these data will be used in research publications, student theses or projects, or for teaching purposes and that the names and any identifying information of individual participants will not be made public - results are only considered in terms of group performance and not individuals. I understand that my personal information will not be directly attached to any of the responses that I provide to the questions. I also understand that my responses will be saved temporarily on the Qualtrics webserver and that they will be downloaded by one of the investigators and securely saved on one computer (which will also be encrypted). I understand that personal information and all data needed to assign bonus course credit and the $5 Amazon eGift card for participating will be stored in a secure place accessible only to the investigators and that these data will be destroyed after the bonus course credit and eGift card have been assigned. All electronic data from the questionnaires will be destroyed seven years after publication of the research.

I understand that this project has been reviewed and received ethics approval from the Trent University Research Ethics Board.
I understand the purpose of this research and the requirements and risks, if any, which are placed on me as explained by the investigator. I have received a copy of this consent form.
I, the undersigned, willingly consent to participate in this study.

□ I agree

If you have any questions or concerns related to this research study, please feel free to contact Karen Mauro, the Compliance Officer of the Trent University Research Ethics Board by email (kmauro@trentu.ca) or phone (705-748-1011 x. 7896).

Appendix L – Study 3 Participant Debriefing Form Time 1

DEPARTMENT OF PSYCHOLOGY
1600 West Bank Drive
Peterborough, ON Canada K9J 7B8
Telephone: (705) 748-1011 x. 7535
Facsimile: (705) 748-1580
www.trent.ca/psychology
Email: psychology@trentu.ca

Participant Debriefing Form Time 1

Study Title: Attitudes Toward Cognitive Enhancement Time 1

Student Investigator: Ms. Heather Patton, Department of Psychology, Trent University, Email: heatherpatton@trentu.ca

Faculty Investigator: Dr. Kevin Peters, Department of Psychology, Trent University
Email: kevinpeters@trentu.ca; Phone: (705) 748-1011 x. 7795

Thank you for participating! You have now completed Time 1 of our study and you will receive a 0.5 bonus course credit for participating. Participants who completed all of Time 1 of the study and who correctly answered two questions that required a specific response (e.g., If you are reading this, Please check 'Strongly Agree') will receive an email in 3 weeks with information on signing up for and completing Time 2 of the study. It is very important that participants complete both parts of the study, so when you receive the email, please sign up and complete Time 2 as soon as possible. More details about the purpose of the study will be provided upon completion of Time 2. Participants who complete Time 2 of the study will receive an additional 0.25 bonus course credit. Those participants who complete all of Time 2 of the study and who correctly answer the two questions that require a specific response will also receive a $5 Amazon eGift card that can be used to make purchases on Amazon's website. The eGift card will be sent to the email address you provided when you signed up as a participant on SONA.

If you have any questions or concerns related to this research study, please feel free to contact Karen Mauro, the Compliance Officer of the Trent University Research Ethics Board by email (kmauro@trentu.ca) or phone (705-748-1011 x. 7896).

If you find that, for whatever reason, you experience any lasting adverse emotional effects in the coming days after completing Time 1 of this study, we encourage you to seek counselling from one of the following services:

Trent University Counselling Centre (students only)	705-748-1386 Blackburn Hall, Suite 113
Four Counties Crisis Hotline	705-745-6484 866-995-9933

Appendix M – Study 3 Time 2 Emails Sent to Participants

Email 1

Hello,

Three weeks have passed since you participated in the online study "Attitudes Toward Cognitive Enhancement Time 1". It is now time to complete the second part of the study. At your earliest convenience please login to SONA and click on the study "Attitudes Toward Cognitive Enhancement Time 2". To sign up for the study you will need to enter the following identification code: **attitudes**

Please sign up and follow the link to complete the survey on Qualtrics. Participants who complete the second part of the study will receive a 0.25 bonus course credit. Those participants who complete all of the second part of the study and who correctly answer two questions that require a specific response will also receive a $5 Amazon eGift card that can be used to make purchases on Amazon's website. The eGift card will be sent to the email address you provided when you signed up to be a participant on SONA.

Thank you for participating in our study.

Heather Patton
heatherpatton@trentu.ca

Email 2

Hello,

More than three weeks have passed since you participated in the online study "Attitudes Toward Cognitive Enhancement Time 1". This is a reminder that it is now time to complete the second part of the study. Please login to SONA and click on the study "Attitudes Toward Cognitive Enhancement Time 2". To sign up for the study you will need to enter the following identification code: **attitudes**. Please sign up and follow the link to complete the survey on Qualtrics. Participants who complete the second part of the study will receive a 0.25 bonus course credit. Those participants who complete all of the second part of the study and who correctly answer two questions that require a specific response will also receive a $5 Amazon eGift card that can be used to make purchases on Amazon's website. The eGift card will be sent to the email address you provided when you signed up to be a participant on SONA.

Thank you for participating in our study.

Heather Patton
heatherpatton@trentu.ca

Appendix N – Participant Debriefing Form Time 2

DEPARTMENT OF PSYCHOLOGY

1600 West Bank Drive
Peterborough, ON Canada K9J 7B8
Telephone: (705) 748-1011 x. 7535
Facsimile: (705) 748-158
www.trent.ca/psychology
Email: psychology@trentu.ca

Participant Debriefing Form for Time 2

Study Title: Attitudes Toward Cognitive Enhancement Time 2

Student Investigator: Ms. Heather Patton, Department of Psychology, Trent University, Email: heatherpatton@trentu.ca

Faculty Investigator: Dr. Kevin Peters, Department of Psychology, Trent University
Email: kevinpeters@trentu.ca; Phone: (705) 748-1011 x. 7795

Thank you very much for participating in our study! You have played a crucial role in the advancement of research in this area. Your time and effort are greatly appreciated.

Here is a little more information about the study you just completed. There is growing debate over the nonmedical use of prescription drugs by 'healthy' individuals (i.e., individuals without medical diagnoses related to the drug in question). For example, studies have reported that anywhere between 5.3% (DuPont, Coleman, Bucher, & Wilford, 2008) and 55% (DeSantis, Noar, & Webb, 2009) of college students have used stimulants (e.g., Ritalin) to help them study or to stay awake longer. Regardless of whether one is for or against the nonmedical use of drugs for enhancement purposes, most agree that there needs to be wider societal engagement and debate on these issues.

The purpose of this study is to examine people's attitudes about the use of a safe and effective drug for enhancing cognitive abilities (e.g., the ability to remember). Please note that although there currently are no such drugs available for healthy people (i.e., those without a medical diagnosis), this

situation may change in the future. This study is part of a larger project to develop a scale that we, and other researchers, will be able to use to assess these kinds of attitudes in a more objective and reliable way.

We expect that we should be finished collecting and analyzing data by the end of the Summer 2016 semester; if you would like a copy of our results or any subsequent publications please feel free to send one of the researchers an email to make such a request.

If you have any questions or concerns related to this research study, please feel free to contact Karen Mauro, the Compliance Officer of the Trent University Research Ethics Board by email (kmauro@trentu.ca) or phone (705-748-1011 x. 7896).

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Four Counties Crisis Hotline	705-745-6484 866-995-9933