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Working smart: the use of ‘cognitive enhancers’ by UK University students

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Cognitive enhancers include a wide range of substances including prescription medication for attentional deficient disorders and pharmacological substances for cognitive augmentation. Students have recently been identified as the largest cohort of users. Most research on student use of cognitive enhancers has been undertaken in the United States. This study utilised a mixed methods sequential explanatory approach to investigate cognitive enhancer use among UK university students specifically to aid study. A bespoke online survey was distributed throughout the UK. The findings informed the development of a qualitative interview study comprising fifteen participants. In total, 506 responses to the online survey were received from 54 UK institutions. 46% of respondents reported using recreational drugs and 19% reported having used cognitive enhancers. Males were two and a half times more likely to use cognitive enhancers than females. Participants reported various motives for using cognitive enhancers, the most frequent being to meet the demands of coursework, to improve focus or maintain wakefulness. The qualitative findings revealed that cognitive enhancers are widely accessible and are used to enhance performance in terms of motivation, concentration and meeting academic deadlines. The findings of this study will be of interest to a wide range of services within Universities across the UK.

Keywords: Cognitive enhancers; students, study aids

Introduction

Pharmacological cognitive enhancement refers to the augmentation of cognitive capabilities using cognitive enhancers such as prescription drugs (drugs intended for medical use only), illicit drugs (illegal drugs) and lifestyle drugs (such as alcohol and tobacco) (Schelle et al. 2015). As these substances may benefit cognitive functioning they have been utilised by healthy individuals, including those in business (Cheshire, 2006; Iorga & Pop, 2017) and the military (Partridge et al. 2011) with the aim of enhancing cognitive performance.

There is much debate about the cognitive benefits associated with non-prescription use of prescription drugs for attention disorders (Arria et al. 2013) yet the non-medical use of stimulants by students seeking cognitive enhancement is now widely reported in the literature (Arria et al. 2013; Nicholson et al. 2015, Riddell, Jensen & Carter, 2018,). This paper is concerned with students' non-prescription use of 'cognitive enhancers' such as Modafinil, developed to combat narcolepsy, Ritalin (methylphenidate) and Adderall (dextroamphetamine) intended as a treatment for Attention Deficit Hyperactivity Disorder (ADHD) with the specific aim of enhancing study (Pliszka et al. 2000; Saletu & Saletu-Zyhlarz, 2013).

While the use of prescription medication for enhanced cognitive performance among students has become more prevalent, most of the research focused on this issue has been undertaken outside of the United Kingdom (UK). A review by Racine and Forlini (2010) identified that rates for non-medical use of stimulants specifically to improve academic performance in the United States (US) range from 3% to 11% in college students. Webb, Valasek and North (2013) report that among medical students in the US, the lifetime prevalence of stimulant

use in their sample (n=144) was 20% with a 15% prevalence whilst at medical school. Of those who reported taking a stimulant, 83% reported using them specifically for cognitive enhancement (for academic study and clinical duties) (ibid). Furthermore, a systematic review by Wilens et al. 2008, found that across 21 studies undertaken in the US involving more than 113,000 participants, between 5% and 35% of university-age respondents reported that they had taken non-prescribed methylphenidate or an amphetamine-based substance. Reported reasons for such use included to concentrate, improve alertness, “get high,” or to experiment (Wilens et al. 2008).

A more recent study by London-Nadeau and colleagues (2019) in the US examined university students’ beliefs about the pharmacological cognitive enhancers use and the cognitive and health effects of the drugs. They identified that participants perceived users as either struggling students or high-achievers and perceived the benefits of use to be enhanced focus, attention, memorization, and grades. London-Nadeau et al. (2019) propose social learning theory as a framework to explain how the experiences of peers may have shaped the beliefs of their participants. This is an interesting development in understanding the non-medical use of stimulants by students seeking cognitive enhancement.

A survey undertaken among students in Australia identified that 6.32% of students indicated lifetime use of prescription cognitive enhancers for the purposes of study-related enhancement (Riddell, Jensen & Carter, 2018). Bell et al. (2013) conducted interviews to examine the attitudes of Australian University students towards cognitive enhancement and found that most of their participants considered cognitive enhancement to be cheating and therefore unacceptable. A small number however felt that taking Ritalin to help with focus and concentration when studying was fair and

acceptable. Those who felt in this way suggested that cognitive enhancement was not a new phenomenon and that the use of Ritalin was simply the latest form of cognitive enhancement (Bell et al. 2013).

Levels of pharmacological cognitive enhancement among students in Europe appear to be lower than reported elsewhere (Franke et al. 2014). In a study by Van Hall et al. (2013), 4.3% of Belgian students reported using neuroenhancers in the previous twelve months but the use of prescription stimulants was much higher during the examination periods compared to other times of the year. Maier (2013) and Sattler and Wiegel (2013) claim 4.56% of German students and 4.1% of Swiss university students respectively reported using cognitive enhancers at least once in their lifetime. Studies have also identified that many students learn about the potential benefits of using cognitive enhancers from their friends (Mache et al. 2012).

There has been very little research on those students studying at a UK university (Ragan et al. 2013). The most comprehensive study performed in the UK was undertaken by Singh et al. (2014). They measured lifetime prevalence for three prescription drugs used for pharmacological cognitive enhancement (methylphenidate, modafinil and Adderall) and identified that lifetime prevalence for methylphenidate was 5.9% with 4% of users taking it for cognitive enhancement. Lifetime prevalence for modafinil was 8% with 6.2% reporting use for cognitive enhancement and lifetime prevalence for Adderall was 3.2% overall and 2% for cognitive enhancement (Singh et al. 2014). This study is now five years old and it would be useful to capture contemporary trends. In addition, there was no qualitative component to add depth to the findings.

By comparing historic research against contemporary figures, it is apparent that the use of cognitive enhancers to aid cognitive function among

students is increasing (d'Angelo et al. 2017). It is also likely that this use will continue to rise given the findings from Singh et al. (2014) who undertook a survey which measured pharmacological cognitive enhancement prevalence among university students in the UK. It was reported that from a sample of 877 university students (mean age 22.7 years), 35 had used Ritalin, 54 Modafinil, and 18 Adderall. A further 164 students had considered using Ritalin, 80 had considered using Modafinil and 110 students reported that they had considered using Adderall in the future. These findings suggest that there are potentially three and half times as many future users than current users. Furthermore, students can procure cognitive enhancers with considerable ease from international manufacturers over the Internet (Rodriguez et al. 2016).

The majority of research that has been undertaken on the use of cognitive enhancers focuses on the prevalence and variety of substance used, rather than the motivating factors and drivers behind such use (Partridge, 2013). Of the studies that have been conducted on students, most participants stated their use of non-prescribed medication was with the aim of improving their grades, more specifically by increasing concentration and alertness when studying (Teter et al. 2006; Micoulaud-Franchi, Macgregor & Fond, 2014; Rami, Hussainy, Henning, Jensen & Russell, 2016).

There are potential health hazards associated with the non-prescription use of cognitive enhancers and as frequency of use increases, so do these potential health hazards (Lakhan & Kirchgessner, 2012). It is therefore important to

understand the influences on students' use of cognitive enhancers and the effect they may have on the regularity of use (Smith & Farah, 2011).

This study, therefore, investigated the prevalence, motivation and facilitators of cognitive enhancer use among a large sample of UK university students. The specific objectives of this study were to:

- Establish the current prevalence of cognitive enhancer use among a sample of UK university students
- Identify the common cognitive enhancers used by students in the UK
- Determine the motivations for student use of cognitive enhancers

Method

Design

This study utilised a sequential explanatory approach (Terrell, 2012) whereby the results from the online survey informed the development of the semi-structured interview schedule. The qualitative data added depth and understanding to the on-line survey findings. The use of the online survey and a combination of face-to-face and telephone interviews facilitated the participation of a geographically diverse cohort from a wide range of UK universities (Vicente & Reis, 2010). Telephone interviews have been shown to provide information that is comparable to face-to-face interviews (Sturges & Hanrahan, 2004).

Procedure

The research was undertaken between January 2018 and May 2018 and was conducted in line with the requirements of the Loughborough University Ethical

Advisory Committee for research with human participants. A bespoke, anonymous on-line survey was developed which was informed through engagement with the literature cited here. On-line surveys offer several benefits over postal surveys including cost savings, time savings and the potential for better completed questionnaires (Vicente & Reis, 2010). The initial section of the questionnaire contained questions to gain general demographic and background characteristics. Participants were then asked if they had used illicit or illegal drugs in a recreational setting in the previous 12 months. These drugs were defined for participants as follows: *'Illicit and illegal drugs are those that are prohibited by law or those which you can't take without a prescription'*. Participants were asked about the following illicit / illegal drugs; Marijuana, Cocaine, Ketamine, MDMA, Valium (without prescription) and LSD. Participants were then asked about their awareness of substances known as 'cognitive enhancers' and if they had used a cognitive enhancer to help with their academic studies whilst at University. Cognitive enhancers were defined for participants as follows: *'Cognitive enhancers are a range of substances that were originally developed with the aim of supporting cognitive function, and include, but are not limited to: Modafinil, designed to combat narcolepsy, and Ritalin (methylphenidate) and Adderall (dextroamphetamine) intended as a treatment for Attention Deficit Hyperactivity Disorder (ADHD)'*. The substances covered in the survey were; Ritalin, Adderall, Modafinil and Armodafinil. The full 21-item instrument (available from the lead author) contained a combination of tick box and open-ended questions and utilised conditional branching (question logic) to ensure that where a positive response was provided to a question, further specific questions were presented creating a more tailored and effective survey (Norman & Pleskac, 2002). These additional questions covered student motivation for using a cognitive enhancer, where the substances were obtained from, effects and side effects of using a cognitive

enhancer. At the end of the survey, participants were invited to participate in an interview and interested participants were asked to contact the researcher directly by email.

The survey was piloted on five students to ensure that questions were coherent and minor changes were implemented to improve the comprehension of some of the questions. Participants provided a unique user ID to maintain anonymity and subsequently improve the honesty and accuracy of answers surrounding a sensitive subject area (Knapp & Kirk, 2003; Ramo, Liu, & Prochaska, 2012).

The survey was sent to all Student Unions throughout the UK who were asked to distribute it online on behalf of the researchers. Additionally, it was widely disseminated across social media platforms such as Facebook to generate a sample from a diverse range of institutions. Participants were not incentivised to participate and no record of distribution by the Student Unions was requested. The survey was available on-line for the duration of the study.

Interviews

Semi-structured interviews were undertaken with a self-selecting sample. Semi structured interviews utilised open-ended questions that enabled the researcher to probe specific areas of interest arising from the online survey (Dearnley, 2005). The sample was purposive in nature (Patton, 2002) in that it included respondents to the on-line survey who had previously used cognitive enhancers whilst at university. Patton (2002) argues that 'The logic and power of purposive sampling lies in selecting information-rich cases for study in depth' (Patton, 2002: p169).

In total, fifteen respondents to the survey contacted the researcher indicating an interest in being interviewed and were subsequently invited to take part in a face-to-face

interview or a telephone interview. Purposive sampling (Patton, 2002) ensured the composition of this small sample would inform the research questions. Participants were assured that any information provided by them would be presented in an anonymised form.

Of the fifteen interviews undertaken, ten were conducted face-to-face and five were undertaken over telephone. The fifteen interview participants were from six UK universities and were aged between 20 and 24 years and 8 (53%) were male. The semi-structured interviews utilised open-ended questions that enabled the researcher to investigate specific areas of interest arising from the online survey. Each interview was undertaken by the same researcher, trained in interview techniques and lasted between 15 and 25 minutes. The researcher was an ‘insider researcher’ meaning that they shared characteristics and experiences with the study participants (Corbin Dwyer & Buckle, 2009). It is recognised that insider research can be beneficial in providing a greater insight and understanding, particularly when conducted on a sensitive subject area (Hodkinson, 2005). The interviews were recorded with the knowledge and consent of participants and subsequently transcribed verbatim.

Data Analysis

Survey Data

The survey data were analysed using the analytic software offered by Online Surveys (formally the Bristol Online Survey) now under license from Jisc, an organisation, providing digital solutions for education and research. Having established no data were missing, simple response frequencies were calculated for questions such as ‘Have you ever used a cognitive enhancer to help with your academic studies whilst at University?’ using the Online Survey’s analysis tool. These are reported in addition to

results from sub-groups of survey respondents. No inferential statistics were undertaken on the data set.

Interview Data

The interview data were analysed using the six-stage process of thematic analysis outlined by Braun and Clarke (2006). The thematic analysis was initially deductive but as analysis progressed it became more inductive as new themes became apparent in the data. The manual transcription and subsequent review of the transcribed data against the original audio enabled a familiarisation with the content, as well as ensuring the accuracy and dependability of the final data set (Stuckey, 2014). Initial notes and ideas were further developed into codes that identified characteristics considered appropriate to the research questions and more specific topic areas that emerged in the online survey. To ensure the trustworthiness of the coding an additional researcher independently coded a sample of the data and similar codes were found to have been applied to the cross-checked section.

A further analysis of the coding combinations allowed the researcher to revise and develop a final series of themes and sub-themes, giving an insight into both the semantic experiences of participant's in addition to more in-depth latent levels of analysis. Finally, specific extracts of the text were selected to illustrate and provide evidence to support the themes identified.

Results

On Line Survey

In total, 506 responses from students registered at 54 recognised UK Higher Education institutions were received. The sample was academically diverse with participants reading for 114 different degrees. Demographic data is shown in Table 1.

[Table 1 here]

Across the sample, 45.5% (n=230) of respondents reported that they had used a range of illicit drugs in the 12 months prior to the study (see Table 2). The percentage of reported use was higher in male participants (49.4%, n=124).

[Table 2 here]

57.1% of respondents stated they were aware of what constituted a cognitive enhancer prior to the study and 36.1% reported that they had been recommended a cognitive enhancer since starting university. Of the entire sample, 19.2% (n=97) reported that they had used a cognitive enhancer to support their academic studies. There was greater use of cognitive enhancers by male participants with male usage reported as being more than two and a half times higher than female usage. Most participants who used cognitive enhancers had also taken recreational drugs (94.9%, n=92). A variety of substances had been used for cognitive enhancement and are shown in Table 3.

[Table 3 here]

The majority obtained their cognitive enhancers from friends (70.1%), while 19.6% acquired them from suppliers on the Internet, and a small minority (3.7%) obtained them from an unlicensed dealer, 6.5% chose to not disclose their source.

Motivations for cognitive enhancer use

Participants reported various motives for using cognitive enhancers. The most frequent reason was to meet the demands of coursework; either to improve focus (74.2%, n=72) or maintain wakefulness (57.7%, n=56)¹. Aiding focus or maintaining wakefulness were also drivers during revision periods. Only 10.3% (n=10) of those reporting using a cognitive enhancer stated they used cognitive enhancers during examinations to improve concentration. These results are in-line with the physiological and psychological effects participants reported experiencing after taking a cognitive enhancer, the most common of which was an improved focus (82.5%, n=82)¹ and increased wakefulness (73.2%, n=71)¹. Additionally, 20.6% (n=20) of those that had used cognitive enhancers claimed to benefit from improved memory.

Although 53.6% (n=52) of cognitive enhancer users were aware of potential side effects, only 38.1% (n=37) reported experiencing adverse reactions. Poor sleep was the most frequently reported negative side effect with nearly a half (48.7%, n=18) of affected participants reporting sleep-related effects, ranging from insomnia to the early stages of psychosis as a result of successive days without sleep. Additional physiological side effects experienced after taking a cognitive enhancer included headaches (24.3%, n=9) and a loss of appetite (16.2%, n=6), while psychological side effects included anxiety (21.7%, n=8) and alterations in personality (5.4%, n=2). Despite being aware of side effects, 82.7% (n=43)² indicated they would use cognitive enhancers again, while an even greater proportion of participants who were unaware of side effects considered further use (91.1%, n =41).

Health concerns were the greatest reported reason for not taking cognitive enhancers (47.4%, n=194). Other reported reasons were moral objections on the basis

that their use may constitute a form of cheating (29.8%, n=122) and concerns over dependency (21.3%, n=87). Additionally, a number of participants were unable to obtain cognitive enhancers (17.1%, n=70) or were unaware of their existence (9.29%, n=38).

¹ Percentage of sample that reported taking cognitive enhancers

² Percentage of sample of cognitive enhancer users that were aware of side effects

Interviews

Three main themes were identified which related to the influencing factors on students' use of cognitive enhancers and the physiological and psychological effects of their use. These were Influences on use, Patterns of Behaviour and Effects. From these main themes, more specific sub-themes were developed.

Influences on Use

A number of factors that enabled and increased the probability of cognitive enhancer use by students were identified, with many participants reporting how social norms were a major influence. Cognitive enhancers were reported as being common, available and socially acceptable.

Awareness

A central component of students' use of cognitive enhancers was awareness of their existence and of the potential benefits they may provide. Multiple aspects including the media, friends, family and university were all found to have the potential to fuel awareness. A 21-year-old male recalled: "*I read an article about it on Facebook and then I just knew people who'd done it and talked to them about it.*" Another 23-

year-old female reported that peer influence was a significant source of awareness of cognitive enhancers and their effects: *“One of my friends had used them and she was swearing by them and said how much it helped her concentrate.”*

Accessibility

The availability of cognitive enhancers was another important factor in determining uptake, with many participants stating that ease of access had been influential in their increased prevalence: *“They're way more accessible so more people are using them and they're more glorified . . . so I think it's due to like how accessible they are”* (23-year-old female). Another 23-year-old female participant provided further insight when acknowledging that an awareness of availability was as influential as accessibility itself: *“They've become more popular as more people are using them more people have realised that they are actually quite easy to get hold of”*

Several participants reported that they obtained their cognitive enhancers through friends, although many were aware that they had been originally sourced online, with one 22-year-old female stating: *“My friend bought them off the Internet and then I bought some off him”*. It also emerged that cost and speed of attainability were significant factors associated with the popularity of cognitive enhancers *“you can get it really easily on the Internet, like in a day and it's fairly cheap”* (24-year-old male). Another participant further acknowledged the lack regulation surrounding cognitive enhancer procurement online:

I was surprised at how easy it was you know to buy something that technically I just really didn't need . . . it's not like you have to scan in your prescription or something like that, it's very much like tick box and go (20-year-old female).

Acceptability

Social norms were identified to be influential on students' attitudes towards cognitive enhancers. A 23-year-old male described the development of social norms regarding cognitive enhancers in academia: *"It's a bit of a taboo thing to take drugs to help you with work, but when there's people talking about it more it becomes more accepted."* One 23-year-old female stated that rather than an anomaly, cognitive enhancer use amongst a healthy student population has become commonplace and subsequently was considered more acceptable: *"Because more people are doing it, it sorts of becomes more normal in a way."* Additionally, it was reported not only had the views of users changed, but perceptions of acceptability had also developed amongst non-users because of its commonality: *"I don't think people who don't take study drugs judge people who do . . . I think it's just quite normalised"* (20-year-old female).

Despite an ongoing debate about the benefits associated with cognitive enhancers, an additional component contributing to the acceptability of cognitive enhancers was students' views over the morality of their use. One 23-year-old female stated: *"I wouldn't say it's unethical or even cheating really, it's just it gives you the ability to apply yourself properly."* Another 23-year-old female used the availability of cognitive enhancers as a justification for their use: *"I wouldn't say it's cheating because it's not giving you any more knowledge and if you want to get them you can."*

Perceptions of safety

One of the central influencing factors on the initial and continued use of cognitive enhancers were students' perceptions of the legitimacy and safety of the substances they were taking. Many used appearance as the basis for appraising the

authenticity of substances; a 20-year-old female illustrated this stating: *“I’m sort of basing my authenticity on the look of it as well, I mean it comes in a proper prescription service.”* Other participants based their assumptions of safety on social verification: *“I had a friend who was taking it a lot and he was taking exactly the same stuff, so I wasn’t worried from like a purity kind of point of view or whether someone had mixed it with anything”* (24-year-old male). Another participant based his decision of the safety cognitive enhancers on the widespread use of other students without serious consequences, the 21-year-old male stated: *“As more people take it it’s a lot easier to just think oh let’s just take it, nothing bad’s gonna come from it”*.

A 23-year-old male reported that he had given consideration to the potential dangers of taking a cognitive enhancer illegally, but determined their origin and historical use to be an indicator of safety, stating: *“As study drugs, Modafinil and such like are used for medical purposes used for I think ADHD or pilots in the air force took them in the past, so to a certain extent they must be safe”* However, other participants had either not considered the detrimental effects or decided that risks were outweighed by reward: *“I’m not very aware of what the risks are to be honest and there are definitely benefits”* (22-year-old male). Another 23-year-old female determined that the potential risks were minimal and at an acceptable level, stating: *“I don’t feel like you could die from it, it would just be, it could just mess up your revision or like your sleep pattern.”*

Patterns of behaviour

A number of behaviours were pervasive across a large number of cognitive enhancer users, these included risk-taking behaviour and a lack of motivation to study. These led to participants’ use of cognitive enhancers.

Risk-taking behaviour

All 15 participants interviewed admitted having used illegal or illicit drugs recreationally with the majority having taken a broad range that included two or more Class A substances. A 23-year-old male described his drug use with a nonchalance that suggested it was not only socially acceptable but also normal: *“[I’ve taken] MDMA, Cocaine, Ketamine, Marijuana, Shrooms, er done acid. That’s pretty much it, just the main ones really.”* There was a common belief that cognitive enhancer use was more likely if an individual had previously used an alternative illicit substance: *“I feel like you’d be more inclined if you’d done drugs before, to take them [cognitive enhancers]”* (23-year-old female). When considering the dangers involved in using cognitive enhancers a 24-year-old male participant stated that they were similar to that of recreational drugs: *“I think they’re much of a muchness . . . they probably run equal risks taking both, especially if you’re taking cognitive enhancers little and often kind of thing.”* Many participants only considered short-term effects and due to the lack of immediate significant dangers were unconcerned of the potentially detrimental effects. *“I think most people perceive it that the risk is so, if not distant, at least quite minimal that they kind of run the gauntlet a bit”* (24-year-old male).

Although some participants were unaware of the risks associated with taking cognitive enhancers, others admitted that they would probably continue to use such substances even if they were better informed: *“I wouldn’t say it would necessarily stop me from taking them, it would just be more of an educated risk when I did take them”* (22-year-old female). This was further emphasised by a 23-year-old male who stated the risk of harm would need to be considerable to prevent their continued use: *“Depending on what results they fed back. I think it would have to be pretty negative and pretty detrimental to my health for me to actually be put off.”* A 20-year-old female reported

that efforts by universities to warn students or prohibit cognitive enhancer use may be futile due to the risk-taking nature of certain students: *“They've done millions of campaigns on drugs and recreational drugs and don't do that and whatever, but students still do it anyway.”*

Motivation

Many of those interviewed chose to take cognitive enhancers in order to assist them when undertaking a considerable quantity of academic work, often in a short space of time. Although in some cases this was the result of extenuating circumstances, for many it was indicative of an underlying issue relating to a lack motivation. A 23-year-old male described how many students view cognitive enhancers as a simple solution:

I think potentially our generation want that quick fix or that easy way to meet a deadline... taking a pill they can get online for a couple of quid seems like a quick way out and makes their life a bit easier.

In contrast to students using cognitive enhancers in order to improve efficiency when time-limited, other participants used them in a proactive approach to overcoming a lack of motivation when commencing an academic assignment:

I've taken them all about like a week to 2 weeks before a deadline . . . If I'm struggling with writing something down or getting focus then I'll do it. I've done it to like get me like started.

Multiple participants described their decision to use cognitive enhancers in an attempt to improve their attitude and application to their studies, with 23-year-old female stating: *“Everyone said that you enjoy your work more when you've taken Modafinil like you find it more interesting, so I thought let's give this a whirl.”*

Periods of Use

Although many participants only initially used cognitive enhancers in their second year, in line with an increase in academic pressures, there was variation in their reasons for initial use. A 24-year-old male described how he first used a substance as a result of a combination of intrigue and peer influence: *“I was very willing to try these things out just to see if it did work. I mean I'd heard a lot of good things about it.”* For a 21-year-old male, procurement was an issue that delayed their first use, suggesting that had they been able to source cognitive enhancers previously they would have used it earlier: *“My second year of university, coming up to my summer exams. That's just the first time we could get any we knew someone who was selling them.”* More commonly, participants recounted first using a cognitive enhancer in response to a particular academic assignment they were struggling with. One 23-year-old female reported her need to increase wakefulness during revision periods as the initiator to her use of cognitive enhancers: *“During like second year so like a couple of years ago during first semester, so it was like during exam period when I had to stay awake more and was doing longer days.”*

Workload

The majority of participants reported using cognitive enhancers during certain time periods and academic endeavours. One 21-year-old female recalled controlling her use of cognitive enhancers, *“I've only took it like, in a small period of time, so over two weeks I'd take it and then that would be it. Sort of like prep for exams and coursework.”*

Participants commonly reported utilising cognitive enhancers when undertaking coursework-based assignments or during revision periods, however, none of those interviewed used a cognitive enhancer during examinations: *“When I had a coursework due, I wouldn't take them for exams it would just be in like the weeks leading up to*

coursework” (22-year-old female). A 21-year-old male further emphasised this: “*I took them in the lead up to my exams to try and made myself less stressed and to keep me up . . . just revision, I never did them on the day of exams.*” Similar reasoning was referred to by another 22-year-old female who reported concerns over the risk of detrimental effects during a critical academic period:

For coursework and things like that, but when I was actually learning it I was worried that it might affect my memory or something in a bad way so I didn't really do it when it came to crunch time.

Another common feature of the workload subtheme were students' beliefs that cognitive enhancers were a necessary support aid in assisting them when faced with multiple deadlines. A 21-year-old male stated: “*First time I used it was in second year, I had four exams one after another and . . . I had to pull an all-nighter before the last exam.*”

Effects

One of the most pervasive themes throughout the data were the effects that students experienced when using cognitive enhancers, although the majority made reference to the positive outcomes, there was also considerable acknowledgement of negative physiological and psychological reactions.

Benefits

The key reason for students using cognitive enhancers were the benefits that they were aiming to receive, many of which were specific to the type of work they were undertaking. The most commonly reported positive effects received related to concentration and wakefulness, “*I only had a positive experience . . . I didn't experience*

anything like heart palpitations or anything like that, but I just felt more awake more alert” (21-year-old male). Another 24-year-old male recalled the remarkable impact that cognitive enhancers had on his ability to focus and work: *“It just removes that block completely. Just sit down and go and I can just flow, the difference is like night and day.”* However, participants were also aware of the limitations of cognitive enhancers and the benefits that they could provide; *“I don't think they make me smarter, I just think they make it easier for me to achieve my academic heights”* (23-year-old female).

Detrimental Outcomes

Many participants acknowledged that cognitive enhancers could be disadvantageous or were accompanied by debilitating side effects. Multiple participants discussed how an intense focus could easily become not only ineffective but also detrimental when applied incorrectly. A 20-year-old female remarked on the risk of such misplaced concentration, *“I try not to do it too close to the deadline because obviously if it goes wrong and you end up staring at a piece of paper and counting the lines all day it's not very useful either.”* For some participants, the hindering side effects of cognitive enhancers were greater than the benefits. A 22-year-old male stated that he suffered from a multitude of negative physical reactions: *“The side effects were just too much for me, like they completely killed my appetite, made me really sweaty, I was just really uncomfortable and then sleep as well, I just could not sleep the day after I'd taken one.”* Another participant reported experiencing adverse psychological effects, *“it would make me like paranoid and anxious when I was trying to sleep as well”* (22-year-old female).

Discussion

This study examined the non-medical use of prescription stimulants among students with a view to supporting their academic study. The study focused on specific

stimulants (Ritalin, Adderall, Modafinil and Armodafinil). The study also covered student use of illicit drugs but did not consider the use of illicit / illegal drugs specifically for cognitive enhancement.

The findings show that 19.2% of those students responding to the online survey reported the non-medical use of a prescription stimulant to help with their academic study. The most common stimulants used were Modafinil and Ritalin. The prevalence identified in this study is in line with levels identified in US and Canadian studies (Racine & Forlini, 2010; Webb, Valasek and North, 2013). However, levels reported by UK students are currently higher than previous results across Europe identified by Van Hal et al. (2013) and Maier et al. (2013) and more than twice that of previous research on UK student populations (Singh et al. 2014). This increase in prevalence identified in this sample refutes previous theories proposing that students are resistant to using cognitive enhancers (Singh et al. 2014).

An awareness of cognitive enhancers and the potential benefits of such stimulants was central in determining their use among participants. Over half of our interview participants reported that peer influence was also highly influential in their uptake of cognitive enhancers and this is in line with previous findings (Mache et al. 2012). Our qualitative findings also highlight that peer influence has a considerable effect on many of the facilitating factors, including students' awareness and ease of procurement, as well as greater acceptance of use of cognitive enhancers within student groups. University academic demands are central to the initiation and continued use of cognitive enhancers making this a student-specific issue. The procurement of cognitive enhancers illustrated the pervasive role of peer influence as a facilitator to cognitive enhancer use, with most respondents to the survey reporting obtaining cognitive enhancers from friends. This peer influence extended to determining the type of

cognitive enhancers used, with Modafinil being the most commonly utilised substance reported in this UK study, in contrast to the popularity of Adderall in the US (Hanson et al. 2013).

Cognitive enhancers were examined in this study solely in relation to academic work, with participants being specifically asked if they have ever used a cognitive enhancer to help with academic studies. The survey established focus and wakefulness as two of the most sought-after effects, which corroborates the perceived benefits of cognitive enhancers for students reported elsewhere (Teter et al. 2006). It is acknowledged that the debate about the effectiveness of prescription medicine in ‘enhancing’ cognition has not been resolved (Arria et al. 2013) yet in both the quantitative and qualitative phases of this study, positive cognitive effects were reported by participants (improved focus, increased wakefulness and improved memory).

While many survey respondents reported perceived benefits from cognitive enhancers, more than half were aware of potential side effects and nearly 40% experienced some negative effects. Some participants reported substantial debilitating effects on their physiological and psychological well-being, directly contradicting previous work that has suggested cognitive enhancers are safe substances (Turner et al. 2003). The commonality and detrimental nature of side effects, such as insomnia and anxiety, raises concerns for the increasing cohort of student users, particularly when situated in the context of increasing mental health issues amongst the student population (Mohammed, 2013).

The use of recreational drugs in this study was found to be a substantial predictor in cognitive enhancer use, affirming associations made in previous research by DeSantis, Noar, & Webb (2009). In our work, cognitive enhancer use was more prevalent amongst students who reported using illicit drugs. Although the gateway drug

hypothesis is unable to conclusively demonstrate drug use pathways, there have been previous significant correlations between the use of multiple illicit drugs (Kandel et al. 2006) and such behaviour may be similarly found with the use of cognitive enhancers. Additionally, cognitive enhancer use was found to be considerably higher amongst male participants, reflecting similar results found on illicit drug use (Johnston et al. 2005).

It is important to consider the limitations of this study: the survey sample was self-selecting, with the decision to participate possibly reflecting participants' specific interests or inherent biases. It can also be argued that the 'insider' status of the researcher may have given rise to researcher subjectivity. However, such a role can lead to a greater level of acceptance by participants and lead to them being more open (Corbin Dwyer & Buckle, 2009). Inferential analyses were not undertaken on this data set, however, the large and diverse sample from this sequential explanatory mixed methods study provided meaningful and informative results. Longitudinal studies are needed to examine the issues identified in this study in more detail including an assessment of the long-term effects of cognitive enhancers in order to provide more informed advice regarding the safety of their use. The interview sample was a small purposive sample and whilst the findings may not be transferrable to a wider population, they are illuminative and useful and may be indicative of wider practices (Kay, 2016).

This study has updated research on the prevalence of cognitive enhancer use by UK students and demonstrated their considerable increase in popularity. In addition, motivational factors and facilitators behind cognitive enhancer use were investigated filling a gap in previous research and subsequently providing a greater understanding of influencing factors on their use. Universities need to develop a greater awareness of the prevalence of cognitive enhancer use amongst their students and consider taking an

active approach in reducing their use. This research should be of interest to UK universities as the possible increase in use of stimulants for cognitive enhancement by students and the reasons behind this are an issue that needs to be addressed by both academic staff and student welfare services.

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