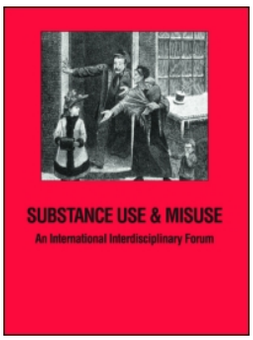

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Building Conceptions of Cognitive Enhancement: University Students' Views on the Effects of Pharmacological Cognitive Enhancers

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ABSTRACT

Background: Use of prescription stimulants for cognitive enhancement in healthy individuals has been of growing interest to the academic community. University students can be prone to use these pharmacological cognitive enhancers (PCEs) for their perceived academic benefits. *Objectives:* We aimed to understand university students' beliefs about the factors influencing PCE use, the cognitive and health effects of the drugs, and how these conceptions are interrelated. *Methods:* Data were collected through focus groups with 45 students at the University of Toronto in 2015/2016. We used thematic analysis to extract key themes and cooccurrence coefficients to evaluate the overlap between these themes. *Results*: We found that participants perceived users as either struggling students or high-achieving ones. Alleged benefits of PCEs included enhanced focus, attention, memorization, and grades, but did not include increased intelligence or long-term cognitive enhancement. Participants disagreed on whether ADHD diagnosis would affect how PCEs worked and how "needing the drug" was determined. Mentions of nonspecific side effects were common, as was the possibility of misuse (e.g., addiction, abuse). Though not an initial aim of the study, we uncovered patterns pertaining to whom participants used as sources of information about different themes. We propose that social learning theory provides a useful framework to explain how the experiences of peers may shape the conceptions of our participants. *Conclusions/Importance*: Our findings highlight that conceptions surrounding PCEs are multileveled, and informed by a variety of sources, including peers. This should be considered in the development of interventions geared toward university students.

KEYWORDS

Cognitive enhancement; pharmacological cognitive enhancers; study drugs; nonmedical use of prescription stimulants; nonprescription stimulant use; conceptions; attitudes; social learning theory; qualitative; focus groups; university students

The study of pharmacological cognitive enhancers (PCEs) has been of growing interest to the academic community, with recent work showing PCE use on the rise (Maier, Ferris, & Winstock, 2018). Pharmacological cognitive enhancement is the illicit use of prescription medications to boost cognitive functioning (e.g., Farah, Smith, Ilieva, & Hamilton, 2014; Greely et al., 2008). Common PCEs include attention deficit/hyperactivity disorder (ADHD) medications such as Ritalin® (methylphenidate) and Adderall® (mixed amphetamine salts), as well as the wakefulness-promoting drug, Provigil® (modafinil).

University students comprise a population of special consideration for PCE use, presenting higher usage rates than other groups, such as their peers who do not attend university (Ford & Pomykacz, 2016) or working professionals (Franke, Bagusat, Rust, Engel, & Lieb, 2014; Johnston, O'Malley, Bachman, Schulenberg, & Miech, 2016). Cultural context also interacts with student usage rates. A recent meta-analysis of American university students reported that PCE usage rates range between 5% and 35% (Benson, Flory, Humphreys, & Lee, 2015). However, European and Australasian estimates are consistently below or in the lower portion of this range (Pighi et al., 2015; Ram, Hussainy, Henning, Jensen, & Russell, 2016; Riddell, Jensen, & Carter, 2018; Singh, Bard, & Jackson, 2014).

Usage rates also vary greatly within countries. In Canada, usage rates differ substantially between provinces (Canadian Centre on Substance Abuse, 2016), which may signal divergence in attitudes toward drug use. For example, comparing the province of the current study, Ontario, with a nearby, culturally unique province, Quebec, reveals differences in drug trends. Ontario was shown to be more favorable than Quebec

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toward tax increases on alcohol to deter use (Macdonald, Stockwell, & Luo, 2011), and rates of cannabis use among youth has been higher in Quebec than Ontario most years between 2004 and 2015 (Leos-Toro, Rynard, Murnaghan, Macdonald, & Hammond, 2019). Additionally, there exists a greater number of harm reduction policies in Quebec than Ontario (Wild et al., 2017).

Risk factors for PCE use reported in university students include individual-level factors such as self-reported attention difficulties (Rabiner et al., 2009), recreational drug use (Garnier-Dykstra, Caldeira, Vincent, O'Grady, & Arria, 2012), low GPA (McCabe, Knight, Teter, & Wechsler, 2005), procrastination tendencies and psychological distress (Ponnet, Wouters, Walrave, Heirman, & Van Hal, 2015), and avoidance strategies to cope with stress (Jensen, Forlini, Partridge, & Hall, 2016; Riddell et al., 2018). Contextual dimensions, which may provide insight into the variability seen in usage rates across academic institutions, have also been reported. For example, having friends who use PCEs (Ford & Ong, 2014), and low perceived risk of PCEs, (Ford & Ong, 2014; Ram et al., 2017; Sattler, Forlini, Racine, & Sauer, 2013), which may be based on a student's social context through friends' reports, can increase the likelihood of use.

Perceptions of the risks of PCEs may vary, in part, because their benefits and risks are not well-established. Primarily, whether these drugs lead to cognitive enhancement in healthy, non-sleep-deprived individuals remains under debate (see meta-analysis by Marraccini, Weyandt, Rossi, & Gudmundsdottir, 2016). Improvement has been demonstrated in areas such as working memory, visual memory, problem solving, subjective task enjoyment, and motivation (Müller et al., 2013). However, enhancement has also been reported as variable and modest, modulated strongly by individual differences and contextual factors (Caviola & Faber, 2015; Farah et al., 2014; Repantis, Schlattmann, Laisney, & Heuser, 2010). Similarly, while the overall safety of ADHD medications has been established in large-scale studies (e.g., Cooper et al., 2011, but see also Dalsgaard, Kvist, Leckman, Nielsen, & Simonsen, 2014), these studies may not extend to the use of these same drugs by individuals whose dosage and frequency of use are not being monitored by a physician. Hence, the question of the cognitive and health effects of PCEs is one that may be particularly influenced by the anecdotal evidence circulated within a given social context.

Social learning theory has shown promise in explaining how these contextual factors may translate into PCE use (Higgins, Mahoney, & Ricketts, 2009), whereby deviant behavior (i.e., the use of PCEs) is learned through social factors such as associating with deviant peers and adopting positive "definitions" (i.e., conceptions of deviant behavior; Akers, 1985). For example, Peralta and Steele (2010) reported that a combination of social learning variables accounted for 39% of the variance in lifetime PCE use of university students. Additionally, Ford and Ong (2014) found that social learning measures influence one's likelihood of use.

Understanding the conceptions of university students toward PCEs is thus a meaningful starting point to understanding usage practices. Considering the limited exploration of the topic in predominantly Anglophone Canadian cities (e.g., Kolar, 2015; for insight into the context of university students in Quebec, see Forlini & Racine, 2012 and Thoër, Robitaille, & Duetto, 2014), we endeavor to illuminate students' beliefs about PCEs at a large university in Ontario. This study provides a multi-faceted representation of these views: the first three components, factors influencing use, cognitive effects, and health effects, are elaborated here, while the fourth, ethics, will be discussed elsewhere (London-Nadeau, Chan & Wood, unpublished data). We also note what sources students used to inform their conceptions.

Table 1. Demographic information of the participants ($N = 45$).

PARTICIPANTS ($N = 45$)	
Age (mean)	20.42 years
GPA (mean)	3.4
Gender (*n* female)	31
Ethnicity (*n*)	
Chinese	11
South and East Asian	16
White/Caucasian	9
Other (e.g., Latinx, Egyptian)	9

Methods

Participants

Data were collected from 45 University of Toronto students (Table 1). Although White participants were slightly underrepresented, the considerable ethnic diversity in our sample was representative of that of the city of Toronto (Statistics Canada, 2016). Participants were high performing, with an average GPA of 3.4/4.0. Participants were at least 18 years old and currently attending the University of Toronto. They were recruited through posters around the university's campus, posts on social media and word of mouth. Informed consent was obtained from each

participant either over the phone or in person. As compensation for their time, participants received food and drinks, course credit, or a cash payment of $10 CAD. All procedures were conducted in accordance with a protocol approved by the Research Ethics Board (REB) at the University of Toronto.

Focus groups

11 focus groups were conducted, with 3–7 participants per group. Sessions were led by an undergraduate research assistant to promote an atmosphere in which participants were free to talk among their peers. An additional undergraduate research assistant was present to take notes to guide later transcription. Focus groups were run until saturation of new ideas was observed.

Participants filled out short demographic questionnaires, then were presented with a short preface that briefly defined PCEs as "prescription drugs like Ritalin, Adderall or Provigil that are used without a prescription to help with coursework or studying." The term "study drugs" was used rather than PCEs. We must note that although this term is more commonly used in our university (e.g., Kolar, 2015), it misleadingly indicates effectiveness, which has not yet been empirically supported (e.g., Racine & Forlini, 2010). Nonetheless, this term was used to ensure relevance to participants. A brief discussion about caffeine started the conversation in order to allow participants to ease into the discussion about PCEs.

Focus groups lasted between 45 and 75 min. Sessions were recorded using two digital recorders for later transcription. A semi-structured interview schedule was used to address three major themes: factors influencing PCE use, cognitive effects, and health effects (Appendix A). As participants were often engaging in the focus groups with peers they did not know, they were encouraged not to disclose their own illegal activities to us, and report these activities as a friend's instead.

Analytic strategy

The audio files of the sessions were transcribed by undergraduate researchers. Coding and analyses were conducted using Atlas.ti 7.5/8 Qualitative Data Analysis Software (Berlin, Germany). Using thematic analysis, a coding scheme addressing the three main themes was inductively built, which allowed for the inclusion of new themes throughout the coding process (Appendix B). Coding was completed first by one researcher, then reviewed by two others. Discrepancies were discussed until consensus was reached.

Thematic cooccurrence coefficients were generated as indicators of the strength of the relationship between two codes to pinpoint which themes were often discussed in conjunction. Frequencies of themes and sub-themes were also recorded to provide an indication of consensus.

Results

Our analysis identified several emergent themes and sub-themes that were discussed throughout the focus groups (Table 2).

The use of focus groups allowed unexpected themes to occur through conversation between the participants. While we constructed our study to understand *what* participants knew about the effects of PCEs in their academic environment, we uncovered a considerable amount of information regarding *how* the participants were informed about different themes, as well. Importantly, we found that participants trusted different sources to provide them with information depending on the theme discussed. As a result, we present both the content of participants' views toward PCEs as well as the source that informed these views, if mentioned.

The co-occurrence analysis revealed several key linkages between themes that had comparatively high rates of co-occurrence. The top 10% of co-occurrence frequencies are reported in Figure 1, which illustrates this network and incorporates the main informant(s) for each theme, thus creating a conceptual map of how PCE use was understood in our sample. Themes and sub-themes are explored in turn below.

Factors influencing PCE use

When discussing their academic setting and its relationship to PCE use, participants described certain environmental and individual factors that could affect use. The link between central effects (i.e., main cognitive effects of PCEs) and factors influencing PCE use in Figure 1 demonstrates that these factors were important in how participants understood the effects of PCEs.

Environmental factors influencing PCE use

Some participants noted that being in a university made access to PCEs particular easy:

> 11.F: "Especially in a student-based environment, [access is] easier than out in in the work-place."

Table 2. Thematic and subthematic frequencies. Subthemes that were expressed by 10 or more participants were deemed "common," those expressed by 6–9 participants were considered "frequent," and those mentioned by 4 or 5 participants were referred to as "occasional." Subthemes expressed by 3 or fewer participants were excluded from the final analysis.

THEME	SUB-THEME	FREQUENCY
Factors Influencing Study Drug Use (*coded 558 times*)		
a. Environmental	Rates Now: Higher than before because more access	Occasional
	Access is easy	Occasional
b. Individual	Students in general: Trouble focusing, bad study habits	Occasional
	Users: Procrastinators	Frequent
	Users: Distracted, need to concentrate, not doing well	Frequent
	Users: Maintain high GPA	Occasional
	Users: Have a bigger workload, harder programs, more pressure	Frequent
	Users: In grad school/law/med school	Occasional
	Users: More about personality than major	Frequent
	Users: More likely to use street drugs	Frequent
	Users: Have to rely on the drug	Occasional
Cognitive Effects (*coded 610 times*)		
a. Central Effects	Is a shortcut/aid	Common
	Increases focus	Common
	Helps memory	Common
	Helps grades	Common
	Does not make you smarter	Frequent
	Leads to short- but not long-term improvement	Frequent
	Restricted to person's abilities	Frequent
	Risk of focusing on the wrong thing	Frequent
b. Caffeine and Central Effects	Keeps you awake/decreases need for sleep/increases energy	Common
	Increases efficiency/focus/concentration	Frequent
	Has beneficial effects for me	Frequent
	Coffee doesn't do anything for me/has unwanted effects for me	Common
c. Diagnosis and Central Effects	Study drugs work similarly for people with and without ADHD	Frequent
	Hard to decipher what is ADHD and what is lack of focus	Frequent
	Prescription is protective of side effects	Frequent
d. Diagnosis and Need	Need requires a diagnosis	Frequent
	Need does not require a diagnosis	Frequent
	Need may suggest that the student has ADHD	Occasional
	No relation between effectiveness and diagnosis	Frequent
	Only doctors and medical professionals can diagnose	Frequent
Health Effects (*coded 248 times*)		
a. Side Effects	General mention of the possibility for side effects	Common
b. Misuse	Risk of harm/vague conception of "risk"	Frequent
	Risk of relying/dependency	Common
	Risk of addiction	Common
	Risk of misuse/improper use/abuse	Frequent

This, combined with increasing academic and extracurricular expectations, led our participants to hypothesize that rates of PCE use were currently higher than they had been 10 years prior, which is consistent with some estimates (McCabe, West, Teter, & Boyd, 2014):

> 32.F: "I think over the past 20 years academic standards have probably increased, so more people are stressed and you probably tend to go use [PCEs] more."

As such, the academic setting was viewed as both a facilitator and a trigger of PCE use.

Individual factors influencing PCE use

Some participants mentioned that a considerable portion of students at the university experienced trouble focusing or had poor study habits, and that these were barriers that might impede students' academic success.

Participants also communicated their specific assumptions and opinions about PCE users. Their estimates of PCE use ranged between 5% and 30% of students, with most estimates falling between 5% and 15%, mirroring research findings (see Benson et al., 2015, for a recent meta-analysis). However, their opinions differed regarding the characteristics of the students who constituted this proportion.

Struggling students will use. Several participants expressed the view that PCE users were most likely procrastinators:

> 33.F: "I kind of see them like, more like procrastinators, people who tend to go out a lot or go hang out with friends a lot, and then take studying last minute. So maybe they need to focus really hard, so they need the drug."

Another sizeable portion felt that students who resorted to PCE use were most likely those who had

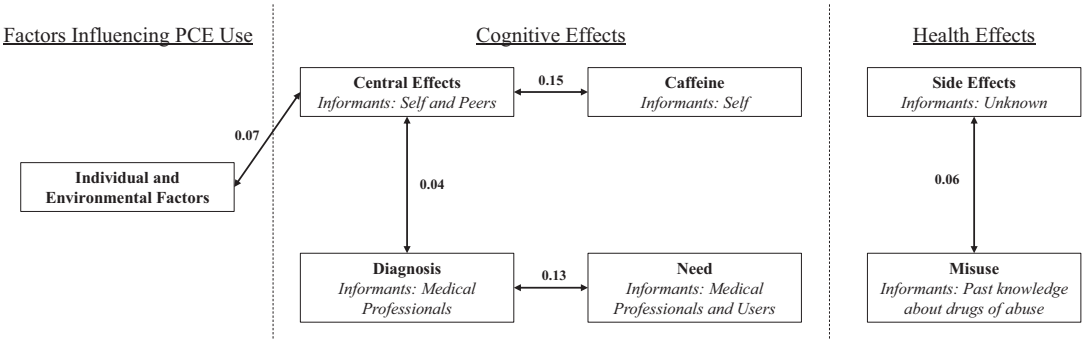

Figure 1. The thematic network of factors influencing PCE use, cognitive effects, and health effects. The top 10% of the most frequent co-occurring themes generated using Atlas.ti are linked with arrows and their respective coefficients. Participants' views about the "Individual and Environmental Factors Influencing Use" shaped their opinions about the ways in which study drugs work ("Central Effects"). The latter was related to "Caffeine" and "Diagnosis." In turn, "Diagnosis" was commonly discussed in conjunction with "Need" for the drugs. Both themes under "Health Effects," "Side Effects," and "Misuse," had considerable overlap only with each other.

difficulty concentrating, were not doing well in school and perhaps were on the cusp of failing.

High achievers will use. PCE users were also viewed as those who were under a great deal of pressure and highly motivated to maintain a high grade point average (GPA), or were in difficult programs:

> 33.F: "I think for people who have...much...tougher programs, they would tend to lean towards [PCE use] because competition there would be very high and they feel the pressure to do better than everybody else."

Some participants stated specific programs including graduate, law, or medical school as producing this kind of pressure. However, most participants contended that use was determined more by personality or other circumstances than by program.

Other factors and concerns. Participants frequently mentioned other assumptions about PCEs users, including that they were more likely to also use street drugs, an assumption supported by previous research (Garnier-Dykstra et al., 2012). Furthermore, participants occasionally expressed that once users started taking PCEs, they would come to rely on the drug, and this would be detrimental in the long-term when skills and knowledge, rather than grades, act as performance indicators:

> 32.F: "[I]n the future if you go into the working world, sometimes if you don't just want to rely on drugs, you have to rely on your own willpower and your own mental power, so I would say in the long run, it doesn't really help in developing psychological strength."

Additionally, especially for those who believed users struggled in school, PCE use was both indicative of and a precursor to the development of poor study habits. This echoes the perceived cyclical nature of the academic context as both encouraging and facilitating PCE use. Altogether, factors influencing PCE use were more often perceived to be individual characteristics, but the academic setting was key in facilitating and encouraging this use.

Cognitive effects

Central effects of PCEs

Central effects (i.e., the cognitive effects of PCE use) comprised a major theme discussed by our participants. It will first be discussed alone, then in relation to the other themes with which it co-occurred frequently.

Benefits of use. Several participants contended that the drugs provided an "aid" or "upper-hand." Specifically, a central point of agreement among participants was that PCEs increase focus:

> 3.M: "From what I understand, it improves your concentration and ability to focus on a single or few tasks very well. So if you're trying to memorise a certain set of information, for example, that would help very much."

This participant also expressed another typically-held view: PCEs increase the ability to memorize. These benefits were intertwined in that several participants felt that an enhanced ability to focus encouraged superior memory retention. In turn, grades and assessments were viewed as amenable to improvement through PCE use, as they were perceived to measure memory, primarily.

Limitations of use. Limitations were included among benefits. For example, a considerable portion of

participants rejected that PCEs increased intelligence. Similarly, while most participants believed enhancing effects could be achieved using PCEs, many felt that these effects would not be long-lasting. Participants debated about whether effects were confined to students' abilities, off-drug, or if PCEs conferred an advantage beyond what users were otherwise capable of:

> 11. F: "[I]f there's a really smart person and then this not so smart person is taking this [PCE], I don't know if that will have [a] better effect and make them have higher grades than the person who's actually smart."

> 13. F: "[I]f you're using drugs it's like not your brain anymore, it's your brain plus the drugs."

Participants who advocated for the former also mentioned the necessity of "putting in the effort" to reap the drugs' rewards. Thus, while PCEs were understood to provide benefits for simple and short-term cognitive tasks, they were also viewed as having limited, or even detrimental effects on more complex and long-term capabilities.

Caffeine and central effects

While discussions of caffeine were included with the main aim of initiating conversation, we found an interesting relationship between caffeine and its central effects. Unsurprisingly, a considerable portion of participants put forth that caffeine had several benefits including increasing wakefulness and energy levels, and that caffeine was helpful with studying, in their own experience. However, an equally sizeable portion noted instead a lack of effectiveness in their experience with caffeine:

> 45. F: "[Coffee] doesn't work for me either, but I take it, I drink caffeine, 'cause I think it would have like some sort of placebo effect. Makes you feel better. Like it's helping, but it's not."

Diagnosis and central effects

The effectiveness of PCEs was commonly discussed in the context of the absence or presence of an ADHD diagnosis, raising questions about the drugs' function in each population. The dominant opinion was that PCEs affect students with and without ADHD similarly:

> 24. F: "I just think it makes you focused more [sic], and I think anyone has the capability to focus more, but I don't think you have to have ADHD for it to work."

Furthermore, several participants highlighted their difficulty in distinguishing ADHD from bad study habits. This lack of clarity surrounding ADHD status made the link between diagnosis and the effectiveness of the drugs difficult to articulate for those participants.

Diagnosis and need. Participants often found it important to distinguish between users simply wanting to take the drug, or in fact "needing" it. Several participants argued that an ADHD diagnosis determines need, while others held that diagnosis was not necessary to establish need for the drugs:

> 36. F: "[I]f they didn't have a prescription for it, then they didn't really need it."

> 34. F: "[M]aybe they don't have a medical condition but maybe their aunt passed away on the weekend before and they needed this right? So … it's really blurry, the lines of why they need this, so maybe they had a bad childhood but there's no medical way to prove this."

For others, yet, self-diagnosis could signal need. Conversely, to some, need could indicate a case of undiagnosed ADHD. Altogether, participants viewed need as intimately related to PCE use.

Health effects

Participants recognized that the use of PCEs could produce detrimental health effects. This was apparent in their general concern about the "harm" these drugs could cause:

> 45.F: "[P]eople don't know about how harmful [PCEs] could be."

In particular, the potential for side effects and misuse of the drugs constituted the main health concerns expressed by our sample.

Side effects

While specific side effects were discussed by only a small portion of our sample, nonspecific side effects were far more commonly mentioned. Often, these effects were attributable to the fact that these are drugs:

> 44. F: "Taking any type of pill would have side effects. And taking one that could increase your attention and focus, I don't know what that would do to your body, but … especially long-term use. Could be really bad."

Therefore, although the possibility of side effects was clear, few participants could state specific

examples. Certain caveats were also placed on use, with factors such as dosage, timing, and frequency being cited as important in determining if use would lead to side effects.

Misuse

Health considerations also included the potential for misuse of PCEs, beyond their use without a prescription. Misuse was commonly characterized as needing to rely on PCEs to perform. While a large portion of participants simply described this behavior as being "reliant" or "dependent" on PCEs, another large portion likened this type of use to the more compulsive and severe reality of addiction:

> 40. F: "I think [seeing improved grades] boosts the whole being addicted to it more and more, because you see the effects of it."

Together, participants who expressed reliance, dependency, or addiction as examples of misuse constituted a majority of our sample. The risk of "abuse" was also commonly mentioned, generally conceptualized as either unacceptably high dosage or frequency of use.

Sources of information

Although not explicitly prompted, participants often expressed how they obtained information about their views, identifying the key informants guiding their opinions. When discussing the main effects of PCEs, we discovered that participants virtually exclusively gathered evidence to support their claims through their peers' experiences (or their own):

> 21. M: "[M]y friend does it and I know what the effects are, it['s] just really for your attention, it just concentrates you, [it] kind of stops your thought process so you can really concentrate on things you're doing."

Strikingly, participants made no reference to the media, medical professionals or academics as informants about the central effects of PCEs. Furthermore, none of our participants discussed an instance in which they, themselves, or their peers had an experience in which PCEs simply did not have an effect, as some empirical findings suggest. The only discussions of the drugs not "working properly" included the effect of focusing on the wrong thing:

> 1.M: "I have a friend that took it and it basically gets you really focused. It helps you remember stuff, but it's really [easy] to get off track when you're doing it. It's like when you take it and you go on YouTube and be watching [sic] videos for like three hours."

It is important to note that we explicitly told participants not to admit to illegal activities and to instead state that a friend engaged in the activity they wished to discuss. Thus, it cannot be disentangled whether participants were using their own experiences or others' when mentioning friends' experiences. Nonetheless, focus groups provide a window into how students may discuss this topic outside of a laboratory setting, and show us that instances of the drugs being effective – and not those of the drugs being ineffective – are relayed. This suggests that discussions about the effectiveness of PCEs between peers focus on instances when the drugs provided noteworthy (often beneficial) effect.

When it came to caffeine, a drug virtually our entire sample reported using, participants could openly use their own experiences to inform their views about its effects. Furthermore, when discussing their own experiences, participants relayed both the presence and the absence of an effect. This contrasts discussions about PCEs, in which only the presence of an effect was communicated.

Unsurprisingly, participants accorded a high degree of authority and trust in medical professionals when it came to discussions of diagnosis. To illustrate this confidence in physicians, participants often expressed that users who were prescribed the drugs were safeguarded from any potential side effects:

> 10. M: "If it's going to affect your health, then you don't need it. I'm talking about someone who has a learning disability, who needs the drug."

Conversely, medical professionals had a more mitigated role when it came to informing who needed the drug. For some, medical professionals were the only ones who could ascribe need through diagnosis. However, for others, users themselves held the authority to determine their own need.

Since discussions of side effects and misuse were typically general and vague, information about the source of this knowledge was not mentioned. Opinions seemed to be formed from participants' knowledge about how drugs work, in general. This presents a stark contrast to the use of peers (or possibly oneself) as informants about specific benefits (except for focusing on the wrong thing), supporting the idea that positive, but not negative, effects are generally communicated between users and non-users.

Discussion

Focus groups provided a platform for our participants to discuss their beliefs about the characteristics of

PCE users and the effects of the drugs. These ranged in specificity (benefits were highly specific, side effects were mostly general), consensus (agreement about the central effects of PCEs, contention about the interaction of central effects with ADHD status), and informing agents (one's own experience as the primary source of information about caffeine, medical professionals and users for determination of needing the drugs).

We found that students described their university environment as both an instigator and a facilitator of PCE use. This is consistent with related findings (Hildt, Lieb, & Franke, 2014) that underscore the pivotal role of perceived environmental pressure as a precursor to use.

When describing PCE users, we found that participants were split between imagining them as struggling students or high-achieving ones. These findings echo the conceptions of students in other studies (Partridge, Bell, Lucke, & Hall, 2013) and are consistent with risk factors identified in related analyses (McCabe et al., 2005; Ponnet et al., 2015; Stoeber & Hotham, 2016).

Furthermore, we found that participants could list several benefits and limitations of PCE use, but did not consider the possibility for a lack of effect altogether. This finding contrasted discussions of caffeine, a much more common substance recognized by some as ineffective. This may have been due to caffeine's higher prevalence or lower potency. This could also suggest that students preferentially communicate effective drug experiences, so students only recognize the lack of an effect when they have experienced it directly.

Participants expressed that PCEs were effective for increasing focus, memory, and grades, and could provide a "boost." The idea that PCEs can improve focus and memory has previously been reported (DeSantis, Webb, & Noar, 2008; Hildt et al., 2014; Partridge et al., 2013) and constitutes the primary reason for use in related studies (Judson & Langdon, 2009; Rabiner et al., 2009). These conceptions of PCEs being beneficial in an academic context, known as "definitions" under social learning theory (Akers, 1985), have been determined to be a risk factor for future use (Ford & Ong, 2014).

However, participants stated that the drugs would have limited success in increasing intelligence, or producing long-term effects and new abilities, which echoes previous Ontarian findings (Kolar, 2015). This mirrors the reticence of actual users to report far-reaching benefits of PCE use (Hildt et al., 2014).

Additionally, we found that discussions of central effects often considered ADHD status. Participants noted how difficulty disentangling ADHD from poor study habits could also affect this relationship, and were equally ambivalent when it came to determining who "needed" the drugs. As need has been recognized as a component related to acceptability (Cabrera, Fitz, & Reiner, 2015), this finding may help expand our understanding of this relationship, as it suggests that need may in fact be determined more broadly than simply through a medical diagnosis.

While participants could list specific benefits and limitations of PCEs, rarely could they do the same when asked about side effects. The possibility for side effects in general was noted, however, demonstrating that the definitions surrounding PCE use were not unilaterally positive. Several possibilities for misuse were also articulated; the most widely discussed were dependency and addiction. Aspects of our findings parallel those of a study out of Quebec (Forlini & Racine, 2012), in which some focus group participants reported the presence of risks with PCEs, due to either lack of information about the effects on healthy individuals or dependence. However, other participants reported the lack of risks, pointing to the regulation of drug production and the fact that doctors prescribe these drugs. This is different from our participants, some of whom indicated that a prescription medication could still have side effects if administered without a prescription. This divergence may reflect cultural differences in opinions about the acceptability of drug use between the two regions, with Quebec showing more acceptance through measures such as a higher rate of youth cannabis use (Leos-Toro et al., 2019).

We also unexpectedly discovered a good deal of information about whom participants trusted to provide them with information about different aspects of PCE use. This signals that an important step in understanding how views are shaped is recognizing who is shaping them. These findings point to social learning theory as a relevant framework to explain how beliefs around deviant behavior are socially constructed – a process that may then translate into use. Our results inform the construction of these "definitions," which seem to be formed principally by friends and peers (and, potentially, oneself), who were the principal informants about the benefits and limitations of PCEs. However, this also differs from previous work, which found that students turn to the internet to gather information about PCEs (Thoër et al., 2014).

Furthermore, while specific benefits were mentioned by a majority of our sample, specific side effects were not. This might be because peers are not relaying information about side effects, or because they are simply not experiencing them. Regardless, either of these may explain how having friends who use PCEs also produces a low perceived risk of use. Thus, having friends who are users may be a risk factor for use (Ford & Ong, 2014) because of the type of information being relayed (i.e., mostly beneficial effects).

One important implication of this discovery is the potential to create focused approaches to intervention and information dissemination about PCEs at universities. Universities have been posited as the starting point for much PCE use, and, therefore, bear responsibility in educating students regarding the realities of the drugs (Rosenfield et al., 2011). Since we have identified peers as key gatekeepers of information about the effects of PCEs, our results suggest universities may benefit from prioritizing peer-to-peer education about these drugs. Our findings also indicate that interventions should align with cultural context, which interacts with beliefs about PCEs (e.g., their ability to produce side effects). Peer-to-peer education would help ensure cultural relevance. In fact, drug education delivered in a peer-to-peer setting has already demonstrated particular promise (Ripley, 2005), and may be a successful method to address education on PCEs.

Limitations

Our study has certain limitations. First, for confidentiality reasons, we did not ask participants about their own history of using PCEs. This precluded us from knowing when participants were truly referring to a friend in their narratives, or when they were following our instructions to mask their own illicit activities. Future research would benefit from knowing user/non-user status to explore this question further.

Second, we did not directly question participants on how they knew about the effects of PCEs, as this was an unexpected line of inquiry. This constitutes a promising avenue for future research that could explore the relationship between information, views, and behavior.

Conclusion

This article provides insights into the ways that university students view the effects of PCEs. We found that students were generally better informed about the central effects (both benefits and limitations) of PCEs than about their side effects, but still highlighted the potential for misuse. We also found that participants perceived a complicated relationship between these effects, ADHD status, and need. Additionally, we discovered that participants were using different sources to inform their views, depending on the aspect of PCE use discussed, which posits these informants as an important part of understanding conceptions of PCE use in university students.

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The authors declare that they have no conflict of interest. The authors alone are responsible for the content and writing of the article.

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Appendix A

Focus Group Interview Schedule

Conversation starter

The conversation starter should cover the points below, but should be stated in a conversational style, not read verbatim.

To get started, let's go around the circle. I'd like each of you to state your name for the session (what's on your nametag) and tell us (pick one of the following questions, or something similar in order to get participants talking):

- What is your favorite coffee shop on campus?
- Which coffee shop do you like to study in?

Themes and Questions

These are a comprehensive list of potential topics to cover. The focus group should be conducted in a conversational manner; these questions should not be asked verbatim. Many of the questions will perhaps overlap with what focus group participants say without being asked directly. It is up to the discretion of the discussion leader which questions to ask in order to cover the themes sufficiently, given time constraints.

General & Cognitive Effects

- Does caffeine increase focus?
- Decrease the need for sleep?
- Enhance cognition ("make you smarter")?
- To what extent does it help?
- Do study drugs increase focus?
- Decrease the need for sleep?
- Enhance cognition ("make you smarter")?
- To what extent do they help?
- What do you think rates of study drug use at this university are?
- Are these higher or lower than 10 years ago in your opinion?
- Do ADHD medications only "work" in people who have ADHD?
- If someone takes Ritalin, and is able to focus better, does that mean that person has ADHD?
- How easy do you think it is for students to get study drugs?
- What kinds of students do you think use study drugs?
- What kind of GPA do they have?
- What major are they in?
- How likely would they also be users of other drugs?
- Do you think use of these drugs leads to better grades?

- Better work?

Health Effects

- What are the risks and/or side effects, if any, of taking study drugs?

Ethics of Use

Questions about the ethics of use were also asked and will be discussed in another publication.

Appendix B

Coding Scheme

Coding Procedure

Codes represent a general theme (i.e., specific subject matter). If applicable, statements may be coded with a valence indicator (Facilitation vs. Inhibition, Absence vs. Presence) that acts as a qualifier of how the code is being discussed. If the theme is simply being noted, but no valence codes are applicable, then the simple code without a valence indicator suffices. Each theme that has applicable valence indicators also has a "Super Code," which collapses the neutral and valenced iterations of a code into one main theme.

List of codes

Caffeine: Any discussion about caffeine (regardless of form). Possible codes:

- Caffeine

Central Effects: Beliefs about if and how the drug works. This encompasses anything regarding enhancement and giving an "upper hand." It should be used for positive effects, or the absence of an effect. Negative effects will fall under "Misuse" or "Side Effects." Possible codes:

- Central effects
- Central effects – Absence
- Central effects – Presence
- Central effects – Super Code

Diagnosis: Mention of having a prescription for PCEs or having ADHD. Possible codes:

- Diagnosis
- Diagnosis – Absence
- Diagnosis – Presence
- Diagnosis – Super Code

Dosage: Any mention of quantity/dose/amount of PCEs used. Code:

- Dosage

Factors influencing use: Discussion about what makes students distinct from one another with respect to their likelihood to use PCEs. May be at the individual or group level. Code:

- Factors influencing use

Frequency**:** Mention of how often the drug is used. Possible codes:

- Frequency

Misuse: Mention of the potential for adverse consequences of PCEs as the result of misuse beyond their use without a prescription. Use of this code may be broken down when a more specific meaning is associated to it (e.g., misuse: risk of addiction/dependence, misuse: risk of abuse). General mentions of risky use are simply coded as "misuse." Possible codes:

- Misuse
- Misuse – Absence
- Misuse – Presence
- Misuse – Super Code

Misuse: Risk of Abuse**:** Mention of the dangers of PCEs because of possibility for abuse. Encompasses discussions of "misuse" when this type of use is considered as exceeding acceptable levels. Possible codes:

- Misuse: Risk of Abuse
- Misuse: Risk of Abuse – Absence
- Misuse: Risk of Abuse – Presence
- Misuse: Risk of Abuse – Super Code

Misuse: Risk of Addiction/Dependency**:** Explicit mention of the risk or reality of becoming either addicted or dependent to PCEs. Also used in the context of needing the drug to perform. Possible codes:

- Misuse: Risk of Addiction/Dependency
- Misuse: Risk of Addiction/Dependency – Presence
- Misuse: Risk of Addiction/Dependency – Absence
- Misuse: Risk of Addiction/Dependency – Super Code

Misuse: Risk of harm**:** General mention of harm as the result of drug use. Encompasses reported and potential/hypothetical harm. Must use words such as "harm," "it can be bad [for you]," "damage." Mentions of side effects or more specific instances of harm such as abuse or dependency should be coded under those categories. Possible codes:

- Misuse: Risk of harm
- Misuse: Risk of harm – Absence
- Misuse: Risk of harm – Presence
- Misuse: Risk of harm – Super Code

Need**:** Whether or not PCE use is viewed as unavoidable for success. Different from "dependence" in that need is expressed as stemming from factors out of one's control. Possible codes:

- Need

- Need – Absence
- Need – Presence
- Need – Super Code

Side Effects: Unwanted effects of PCE use. Possible codes:

- Side Effects
- Side Effects – Absence
- Side Effects – Presence
- Side Effects – Super Code

Timing**:** Any discussion of when the drug is taken. Usually discussed in relation to its effects. Code:

- Timing