The uncertainties of enhancement

A mixed-methods study on the use of substances for cognitive enhancement and it's unintended consequences

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Abstract

Aims: The use of substances for cognitive enhancement has become a relatively well-studied phenomenon in recent years. However, few studies deal with the negative and unintended consequences of such practices. This article uses two data sets to explore and discuss the doubt and negative consequences that affect people using substances in the pursuit of enhancing cognition. **Methods:** Data for the study are drawn from an online discussion forum on substances for enhancement and from ethnographic fieldwork carried out among university students in New York City. Taking a quali-quantitative approach, we combine digital text analytic tools with qualitative analysis and readings. **Findings:** Using prescription stimulants and other substances for cognitive enhancement generates considerable uncertainty in terms of unclear effects, varying practices and ambivalent ethics. While the negative effects are not something easily discussed in person, references to them are very common in the online discussion forum. **Conclusions:** People who use substances for enhancement have developed a 'folk pharmacology' that seems to play an important role in how they perceive the negative effects. This may make people who engage in these kinds of enhancement practices less able to make informed choices about their use of these substances.

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Introduction

> I'll take the pill, and it's moderately like magic. My brain will like kick into gear, and be like 'Okay, you're going to write this cognitive neuroscience paper, it's got to be 30 pages long.' And I just go. I put on music, and it's just like those movie sequences where people fly through time. (Debbie, MA student)

There is a certain eagerness and excitement in the prescription stimulant stories that are frequently told among those who use them for cognitive enhancement. The stories that are not so often heard, however, are those expressing doubt and negative experiences. In this article, we argue that the potential for enhancing cognition among users of prescription stimulants makes it difficult to talk openly about their negative or unintended consequences. The last couple of decades have witnessed an increasing scholarly interest in the so-called non-medical use of prescription stimulants, a group of pharmaceuticals used to treat Attention Deficit Hyperactivity Disorder (ADHD) (Han B, 2017; Johnston, O'Malley, Bachman, Schulenberg, & Miech, 2013; McCabe, Knight, Teter, & Wechsler, 2005; McCabe, West, Teter, & Boyd, 2014; Rabiner, Anastopoulos, Costello, Hoyle, McCabe, & Scott, 2009; Rabiner, Anastopoulos, Costello, Hoyle, McCabe, & Swartzwelder, 2009; Sepulveda et al., 2011; Teter, McCabe, Cranford, Boyd, & Guthrie, 2010; Teter, McCabe, LaGrange, Cranford, & Boyd, 2006; Weyandt et al., 2009). Most studies so far are survey-based and positioned within the health and medical sciences – examining patterns of stimulant misuse – with the exception of a few qualitative works that have focused on students' own perceptions and understandings of their substance use (Aikins, 2011; A. D. DeSantis & Hane, 2010; A. DeSantis, Noar, & Webb, 2009; Petersen, 2015; Petersen, Nørgaard, & Traulsen, 2014; Petersen, Nørgaard, & Traulsen, 2015; Vrecko, 2013).

Several scholars indicate the importance of understanding how such enhancement technologies shape or change what it means to be a person, suggesting that the use of such technologies has a number of ethical implications (Brogaard, Petersen, Grue, & Fihl, 2015; Elliot, 2003; Hogle, 2005; Pickersgill, 2015; Rose, 2007). While the qualitative works have uncovered central aspects of such use, however, there are still a lot of knowledge gaps, particularly in terms of understanding not-so-magical accounts of enhancement practices. Concerns about potentially negative aspects of cognitive enhancement have mainly been raised in bioethical debates on inequality, authenticity, coercion and responsibility (M. J. Farah et al., 2004; Greely et al., 2008; Schelle, Faulmüller, Caviola, & Hewstone, 2014), as well as in studies that focus on or include public opinion or that of non-users, displaying a clear difference between users' and non-users' feeling of safety or concern with side-effects (Eickenhorst, Vitzthum, Klapp, Groneberg, & Mache, 2012; Kudlow, Naylor, Xie, & McIntyre, 2013; Schelle et al., 2014). Thus, while a concern with negative aspects is present in users' benefit-risk calculations of cognitive enhancement, most studies show that users find prescription stimulants useful and, taken overall, beneficial (Aikins, 2011).

Interestingly, both users and non-users of cognition enhancing substances tend to overestimate their cognitive effects (Finger, Silva, & Falavigna, 2013; Ilieva, Boland, & Farah, 2013; Schelle et al., 2014), suggesting that the increased motivation, self-confidence and improved mood associated with such substance use (M. Farah, Smith, Ilieva, & Hamilton, 2014; Petersen et al., 2015; Vrecko, 2013) accounts for the stories of how productive and concentrated these substances make those who use them feel. While this is an important part of the story, we suggest that something else is also at stake. Debbie's description of flying through time on Adderall highlights not only the ease with which many users narrate their enhancement experiences, but also the scarcity of accounts of not-so-productive, not-so-effective encounters with enhancement substances – in other words, what could be termed the dark side of their use. This article aims to focus on these less frequently told stories. In order to do this, we draw on two different datasets: digital data from a study of an online discussion forum (hosted on *Reddit.com*) about the use of substances for enhancement more generally, and data from ethnographic fieldwork among university students in New York City.

'Digital' has become one of the central methodological buzzwords in the social sciences during the last ten years, a change in methodological perspective especially driven by the

emergence of so-called 'big data' (see, e.g., Burrows & Savage, 2014): data drawn from a variety of different data sources that share a number of equal propositions. The most important of these may be that they are 'digital traces' of human behavior (Ackland, 2013), that is, the traces we leave behind when we travel the Internet or pass through digitalized systems such as health care. The data used in the present analysis are of this type: traces of online exchanges made by thousands of people engaged in both broad and narrow discussions about using substances for enhancement.

In order to keep track of the vast amounts of social data that are constantly generated and archived online, social scientists have to a large degree started to rethink analytical tools and methodologies for data acquisition (Marres, 2012; Venturini & Latour, 2009). These data can often be quantified in terms of links between actors: an individual commenting on another's social media post (e.g., to an online discussion on a forum-like platform such as Reddit); 'liking' an organizational page (e.g., by clicking on 'like' to express interest and receive updates on a social networking site such as Facebook); or 'checking in' to a business venue (e.g., by indicating his/her presence via a location-based platform such as Foursquare). This makes them attractive in terms of different forms of digital quantitative analysis, most famously social network analysis. While the social sciences have been interested in how these data can be used to describe the social, some scholars have also promoted more syncretic ways of analyzing data by suggesting an integration of quantitative analysis with qualitative case-specific readings (Bail, 2014). The digital data used in this study have, to our knowledge, never been used in published research, yet offer an exceptional analytical opportunity by providing a semi-anonymous forum where discussions of the 'dark sides of enhancements' actually take place, in a format and quantity that facilitates quali-quantitative analysis.

As is the case with much online data, details about the everyday contexts of the experiences described in the discussion forum are limited. Thus, we provide an in-depth ethnographic study as a way to re-contextualize this data. The ethnographic data result from fieldwork relations that developed specifically over time (Haraway, 1988) and, due to the exceptionally good rapport between subjects and first author, reached a level at which participants were open to raising some not-so-magical accounts of using cognition enhancers. This mixed-methods approach provides us with an opportunity to bring to the fore new aspects of the consequences of engaging in enhancement practices by giving a more nuanced understanding of how the use of substances for enhancement not

only makes people 'fly through time' but also influences them in several unintended ways.

Materials and methods

In the following sections we outline our research design, which combines a quantitatively guided qualitative analysis of unsolicited data collected from the online discussion platform Reddit in the years 2010-2017, with qualitative analysis of data from ethnographic fieldwork conducted among university students in New York City in 2013.

Online data collection

We collected 26,410 messages submitted to a discussion forum hosted on the online platform *Reddit.com* by anonymous participants as part of an open discussion on substances for cognitive enhancement and related topics. To collect and analyze this large qualitative dataset, we employed web scraping tools and specialized text analysis software. In the following subsections, we outline the details of this part of the study, which is anchored in both digital methodology and qualitative analysis.

The discussion forum – a so-called 'subreddit' (see below) by the name of *Nootropics* – was mentioned by fieldwork participants as a source of information in regard to using substances for enhancement. To our knowledge, this specific data source has not been used systematically in any previous work within this field. We chose to conduct an analysis of the discussions of enhancement technologies on Nootropics due to the apparent importance of the platform, and the various empirical and methodological advantages associated with using unsolicited online data in this field (see below),.

Reddit.com

Reddit, currently the second largest online community platform (superseded only by Facebook), was launched in 2005 as a generic platform for sharing, rating and discussing either external hyperlinks or user-submitted textual content ('self-submissions'). The website is self-branded as the 'front page of the Internet', and is currently ranked as the seventh most popular website in the world (Alexa, 2018; Singer, Flöck, Meinhart,

Zeitfogel, & Strohmaier, 2014). The content is divided into 'subreddits', sub-forums dedicated to distinct topics. Reddit allows users to create their own subreddits freely, thus facilitating a high degree of specialization within individual subreddits. The website's functionality is similar to that of a classic online discussion forum, with pseudonymous user profiles, 'threads' (i.e., an original post followed by comments) and sub-forums. The key differences are that Reddit is a generic platform that allows users to access a large number of inter-connected discussion platforms through one account (rather than being a separate forum dedicated to one topic) and that users can 'upvote' or 'downvote' posts and comments, making them appear higher or lower within threads, subreddits and ultimately the 'front page' of Reddit (Singer et al., 2014). At the time of writing, there are 1,209,754 subreddits (reddit metrics, 2018).

The Nootropics subreddit

The Nootropics subreddit[1] was created in 2009 for "discussing nootropics and cognitive enhancers". The term *nootropics* was coined in the 1970s by Giurgea (1977) to designate a new class of psychoactive substances (notably Piracetam) which can increase cognitive function (e.g., learning and memory) in the human brain. Giurgea's exact pharmacological definition is reproduced on the subreddit's *Frequently Asked Questions* page,[2] but is also explained in lay terms: "[Nootropics] are drugs, supplements, nutraceuticals, and functional foods that improve mental functions such as cognition, memory, intelligence, motivation, attention, and concentration." The subreddit's wiki[3] (i.e., user-created encyclopedia) lists approximately 200 substances described as "commonly discussed". Among these are amphetamines and psychedelics, which are explicitly excluded from the nootropics category by Giurgea (1982), a fact also acknowledged in the wiki. At the time of writing, Nootropics has 125,627 'subscribers', that is, Reddit users receiving updates about new posts and comments. The discussion varies, but centers on substances, including aspects such as experiences, recommendations, combinations, effects and side effects. Occasionally, external information resources such as encyclopedias and research papers are incorporated into

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[1] https://www.reddit.com/r/Nootropics/

[2] https://www.reddit.com/r/nootropics/wiki/faq

[3] https://www.reddit.com/r/Nootropics/wiki/

the discussion, but mostly it consists in the interactive sharing of first- and second-hand experience. Thus, Nootropics can be considered a *lay* and *personal* source of information on the subject (see Gray, Klein, Noyce, Sesselberg, & Cantrill, 2005) as opposed to a professional source (e.g., a doctor) and/or impersonal source (e.g., an encyclopedia).

As is mostly the case with anonymous online data, the demographic characteristics of the subreddit contributors are uncertain. Contemporary population surveys show that online communities may differ in terms of age and gender from the general population, and that there are significant differences across different platforms (Pew Research Center, 2018). A 2016 survey among US Reddit users found that 67% were male, 64% were aged between 18 and 29 and that 82% had a full or partial college degree (Pew Research Center, 2016). In 2017, one member of the Nootropics community initiated a survey among the members of the subreddit, and among the respondents 91% were male, the mean age was 27 years and approximately half were US citizens.[4] There are 1591 posts in this subreddit written by people who identify themselves as students.

In August 2017, we collected 26,410 threads from the subreddit available through Reddit's API ('application programming interface', i.e., a public interface to Reddit's internal database), with a total of 384,992 comments, all posted between 2009 and 2017. The data were collected via a custom-built web scraper developed in the *Python* programming language,[5] drawing heavily on the Python library *PRAW (The Python Reddit API Wrapper)*.[6] This library supplies specially tailored functions which enable the developer to easily interact with Reddit's API while automatically complying with the Reddit API Terms of Use.[7] The collection of threads and comments took place between March 15th 2018 12:00 GMT and March 16th 2017 13:00 GMT, and the underlying code used is available from authors upon request.

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[4] https://darktka.github.io/

[5] https://www.python.org/

[6] https://github.com/praw-dev/praw

[7] https://www.reddit.com/wiki/api-terms

Using data from online communities

Previous research has shown that online community platforms such as discussion forums are widely used to discuss sensitive or stigmatized topics including health issues (e.g., Tanis, 2008) and illicit drug use (e.g., Murguía, Tackett-Gibson, & Lessem, 2007). These platforms enable the anonymous (or pseudonymous) discussion of sensitive topics (however obscure) across a potentially global network of individuals with similar values and interests (Murguía, Tackett-Gibson, & Willard, 2007). Some platforms become vastly popular, with registered users occasionally numbering hundreds of thousands; examples include Erowid Experience Vaults,[8] one of the first websites to host self-reports on illicit drug use on a large scale, and Bluelight.org,[9] the largest and most active discussion forum focused on harm reduction in illicit drug use. While no previous research has examined the online discussion of substances for enhancement, research on the discussion of psychoactive drugs in a broader sense has shown that these discussions typically involve the sharing of recommendations for specific substances (e.g., Barratt, Allen, & Lenton, 2014), advice on dosage and administration (e.g., Hearne & Van Hout, 2016), detailed descriptions of positive and/or negative effects(e.g., Kjellgren & Soussan, 2011) and advice for reducing associated harms (e.g., Boothroyd & Lewis, 2016).

The advice and knowledge shared via these discussions is often based on first- or second-hand experience, and may thus be considered a type of illicit "citizen science" (Duxbury, 2015) that poses as a "counterpublic health" discourse (Barratt et al., 2014) in opposition to official government health guidance on substance use which usually promotes abstinence or treatment. These citizen science practices and counterpublic health discourses are clearly evident in the discussion forum we analyze, and this type of data can thus provide us with unique insight into the sentiments of a hard-to-reach population, and into the social processes employed to create knowledge and develop group values (Boothroyd & Lewis, 2016; Duxbury, 2015). Furthermore, and especially relevant to this study, data collected from discussion forums are unsolicited by researchers and can thus differ in content from solicited data gained via methods such as interviews or surveys; for example, sensitive or potentially stigmatizing topics may be

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[8] https://erowid.org/experiences/

[9] https://bluelight.org

discussed more openly due to the anonymous mode of communication (see, e.g., Tanis, 2008). In line with this, we expect this data source to be more reliable than self-reported survey data in regards to negative aspects of using illicit or semi-illicit substances for cognitive enhancement.

Using unsolicited online data involves a number of ethical considerations which are unique to this type of material (Markham & Buchanan, 2012). Central to these is the question of whether to regard the creators of the data (e.g. Reddit users) as research participants or not, and thus whether the research may be considered "human subject research (requiring ethical consideration) or merely … secondary textual analysis" (Roberts, 2015, p. 318). This is closely linked to the question of whether content submitted to an online platform is considered public or private by the submitting user, and thus whether the user retains the right to restrict how his or her content is used and stored (Roberts, 2015). Since no broad consensus has been reached on these issues, we choose to base our approach on the most cautious studies previously conducted with similar data within the illicit drugs fields, where ethical considerations concerning the protection of the 'informants' are especially salient (e.g., Bancroft & Scott Reid, 2016; Soussan & Kjellgren, 2014; Van Hout & Hearne, 2017). Thus, we refrain from reproducing any traceable information such as usernames and direct quotations in order to protect the continued anonymity of the Reddit users.

A quali-quantitative approach to text analysis

Apart from the advantages offered by our corpus of data due to its *type* (unsolicited online data), there are a number of other advantages relating to its *size*, which consists of approximately 1.1 million words. Given the right analytical tools, we can utilize a vast textual dataset like this to gain a perspective on an issue which differs from the perspective offered by a close qualitative reading, an approach termed "macroanalysis" by Jockers (2013). The utility of macroanalysis (as either a stand-alone or complementary approach) is that we can analyze more comprehensive datasets, rather than selecting only specific subsets of a data source (e.g., a discussion forum) and thereby potentially introducing selection bias (Jockers, 2013). Analysis of large digital datasets may be conducted in a strictly quantitative manner (e.g., analyzing word frequencies), but can also take the form of what Venturini and Latour (2009) have called "quali-quantitative" analysis. This entails a fluid and 'zoomable' approach to the qualitative/quantitative

spectrum, where counting and reading are constantly combined and integrated. In this study, we use a combination of software tools and qualitative analysis to construct such a methodology; however, we largely favor the qualitative aspect of the analysis, using quantitative measures mainly as a way of guiding our qualitative readings in a more 'objective' or data-driven manner. In the broader field of document analysis, this integration of qualitative and quantitative approaches to text has been highlighted as a useful way of avoiding the potential disadvantages associated with each of these approaches on its own (e.g., O'Halloran, 2010).

Specifically, we use *Voyant Tools* (Sinclair & Rockwell, 2016), an open-source web application which implements an array of analytic techniques from the quantitative text analysis tradition of *corpus linguistics* (see, e.g., O'Keeffe & McCarthy, 2010).[10] This software allows us to gain quantitative insights about our data, which can then guide our closer readings and qualitative analyses. Voyant Tools takes a collection of digital texts (a *corpus*) as input and enables both quantitative and qualitative analysis through its more than 25 tool modules.[11] In our analysis, we use the tools *Terms* and *Cirrus* to inspect the frequency of individual terms in the corpus via frequency tables and 'word clouds' respectively. Additionally, we use the tool *Collocates* to study pairs of terms, which often occur in close proximity to each other in individual texts. Finally, we use the tools *Documents Terms* and *Reader* to find and read the posts in the corpus where the various terms or pairs of terms occur. These tools bridge the quantitative insights gained about individual terms or pairs of terms via Terms, Cirrus and Collocates with the qualitative insights gained by reading the posts where these terms or pairs of terms occur.

We conducted all other data processing and analysis (such as filtering and calculating summary statistics) using the programming language *R* (R Core Team, 2017); the code used is available from the authors on request.

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[10] See http://voyant-tools.org/ for a full-featured online demo of the tool.

[11] See http://docs.voyant-tools.org/ for the full documentation and list of tools.

Ethnographic fieldwork

Ethnographic fieldwork was conducted by the first author over five months in New York City in 2013, as part of a larger study on the use of prescription stimulants among university students (Petersen, 2015). Participant observation took place daily throughout a full semester, beginning with periods in libraries and study centers at three different university campuses. As the semester progressed and fieldwork relations developed, it came to include participation in students' everyday social and academic activities such as classes, coffee breaks, study groups, homework, parties and other social gatherings. In-depth interviews were also conducted on several occasions throughout the semester with each participant. Initial contact was established through email. A recruitment flyer was sent out to students in several departments at two universities asking those who were willing to participate to send an email directly to the researcher to initiate contact. Students who participated in the study were promised confidentiality, and names and places that appear in any written accounts have been anonymized. Informed consent procedures were ongoing throughout fieldwork, so that the participants were always aware that they could withdraw from the study at any time. The study is reported to and fulfills the requirements of the Danish Data Protection Agency.

The 20 students in the study were aged between 19 and 35 years, studying widely different subjects at different universities from BA to PhD level. They were primarily male, Caucasian Americans, with a few exceptions of African-American and Asian background, as well as a few European students. Most of the students in the study used stimulants illicitly, getting them from friends or acquaintances on campus. A few, such as Harrison and Ben, and eventually also Martin, got their own prescriptions through the doctors referred to them by the counseling department of their university. Despite the prescriptions, none of them felt that they had ADHD and had learned from friends and online communities what to say to a doctor in order to get the right prescription (Petersen et al., 2014). Thus, all the students referred to in this study used stimulants as enhancement rather than treatment although the off-label prescriptions tend to blur this distinction (Morrison, 2008).

The interviews followed a topical guide that included 'first experience with stimulants', 'uses of and experiences with stimulants over time', 'effects', 'social aspects of

stimulants', 'ethics and the opinions of others on stimulants', 'worries and concerns', 'acquisition and access', and 'hopes and thoughts of the future'. Combining interviews and participant observation during fieldwork has made it possible to identify differences between what is said and what is done, or, for example, what is hoped for and what is experienced. This is often termed triangulation and described as a way of validating data (Handwerker & Borgatti, 2015). However, in this case triangulation functions not only as a form of data validation, but also as an analytical tool. Students' experiences of doubt and uncertainty were discovered as a result of the interest raised by the relative absence of negative accounts of stimulant use. Sharing social experiences over time with students became a way of building rapport (Bernard, 2006), providing access to 'all-nighters' at libraries or study centers, for example, where stimulant experiences sometimes differed significantly from what the students had described earlier. Thus, the combination of these methods became a useful way of gaining a more nuanced understanding of students' experiences with stimulants than that offered purely by listening to their idealized accounts of intensified productivity and tunnel vision (Petersen et al., 2015).

Interview transcripts and field notes have been coded manually according to principles of grounded theory (Charmaz, 2014), and common themes have been identified across the material. Emerging from this, and of particular importance for this article, is the systematic occurrence of idealized stories of stimulant use, at the same time as the gradual surfacing of doubtful or unproductive stimulant experiences.

A combined mixed method analysis

Before we delve into the analysis, it is important to point out some central differences between the two data sets. While the ethnographic material specifically depicts enhancement practices with prescription stimulants among university students, the Reddit data reflects these practices in a much wider population using a much wider selection of substances. Though there are many indications that the populations of each data set share several characteristics, the online data undoubtedly covers a more diverse population than the ethnographic material. We are in no way attempting to directly compare populations but rather to compare ways of talking about and understanding the use of substances for cognitive enhancement among young people who share a common enthusiasm for the potential of cognitive enhancement through substances. In the

following we present our findings, first from the online data and then from the ethnographic fieldwork. We devote a section afterwards to discussing the findings together.

The subreddit 'Nootropics'

Of the 26,410 posts collected, we focus on 19,891 *self-submissions*: that is, posts which contain original textual content rather than simply a link to external content. We chose to further filter this subset by discarding any posts with fewer than 15 comments (the mean being 14.3), thus leaving us with a corpus of 6,508 posts for analysis. This final filtering ensured that we only analyzed posts salient to the community, in that they succeed in creating above-average engagement and discussion. We chose not to include the comments in the analysis, as these exhibit a much greater variation in word count and depth of content than the original posts. Thus, our analysis is focused on the posts which initiate discussions – questions, experiences, news and so on – rather than the discussion itself. In Table 1Table 1, summary statistics for the final corpus shows that there is considerable variation in the length of the posts (ranging from "See title" to lengthy narratives) as well as in the number of comments they receive, some of them generating rich discussion. We can also see that Nootropics shows a steadily increasing user activity since its creation, possibly reaching a plateau around 2016 (note that the drop-off in 2017 is due to the date of our data collection).

Table 1 Summary corpus statistics

	No. comments	No. words	Year	No. posts
Minimum	**15**	**2**	2010	**13**
Median	**24**	**99.5**	2012	**372**
Mean	**32.86**	**173.8**	2013	**620**
Maximum	**445**	**3,398**	2015	**1,498**
			2016	**1,606**
			2017	**1,212**

As a final data filtering measure, we used Voyant Tools' built-in functionality to remove 'stop words'. Within textual analysis, this refers to terms which are deemed irrelevant to the project at hand (Grimmer & Stewart, 2013), typically because they are purely functional (e.g., pronouns, prepositions and conjunctions) or overly common or generic (e.g., *go* or *everyone*). Note that the definition of a stop word is application specific; some analyses specifically consider the use of common words (e.g., within stylometry; see Biber, 1991), and a term's analytical salience may vary considerably depending on the domain and research questions posed in analysis. We used an externally sourced list of approximately 1,300 English stop words,[12] augmenting it with our own application-specific additions: digits (0-9); three very common URLs (*www.reddit.com, www.ncbi.nlm.nih.gov* and the URL fragment *https*); the topic and title of the subreddit (*nootropic* and *nootropics*); and a number of words which occurred persistently in our corpus but were deemed to be of no analytical interest: *day(s)*, *hour(s)*, *night(s)*, *people* and *time*.

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[12] https://github.com/stopwords-iso/stopwords-iso

Following the words

Using Voyant Tools to count term frequencies in the corpus, we find that the most common term is *effects* (3,246 occurrences), followed by *feel* (2,480), *brain* (1,801), *sleep* (1,720) and *anxiety* (1,577). The term frequencies for the 75 most common words are visualized as a word cloud in Figure 1Figure 1, where the relative size of each individual term corresponds to its frequency in the corpus. This indicates that the discussions in this subreddit are preoccupied with the effects of the substances (including side effects) as well as personal physical and psychological conditions. However, an analysis of individual term frequencies provides us only with superficial and decontextualized insights. To gain a more substantive insight into how these terms are used, they are positioned as points of departure for navigating the material in order to conduct a deeper, qualitative analysis of the content. This approach allows for an interweaving of macro and micro insights (Blok & Pedersen, 2014; Venturini & Latour, 2009).

Figure 1. Top 75 words in the corpus

Content analysis thus begins with the abovementioned five most common terms. When using Voyant Tools to inspect the collocations of these terms, we get closer to an

indication of the context of their application. In the following, we define a collocate as a word that appears within five words on *each* side of the original word (this is the default option in Voyant Tools). The top collocates of *feel* are *effects* (149 occurrences), *tired* (97) and *anxiety* (83). The most common collocates for *sleep* are *quality* (119), *feel* (67) and *melatonin* (47). For *anxiety*, the top collocates are *depression* (181), *mood* (56) and *feel* (49). Using the collocation feature directs our attention to focus more closely on those pieces of text that include these specific terms in close proximity of each other. Let us look at the example of the term *brain*, which gives a clearer result than any of the other words. The most common collocate of *brain* is *fog* (309 occurrences). When making a qualitative assessment of the 228 posts that include this collocation, it appears that the bigram 'brain fog' is used to describe an unclear, unfocused or confused state of mind, with two main trends emerging. Many of the posts explain brain fog as the main reason for using or wanting to use nootropics, in the hope of reducing or removing the foggy state of mind; but in quite a lot of cases, brain fog is used to describe a state of mind that either worsens or suddenly appears after having used these substances. Thus, while 'brain fog' for some is the motivation for using substances for enhancement, for others it seems to be a side effect or unintended consequence of using these substances.

When looking closely at the 151 posts that include the terms 'anxiety' and 'depression' we see a similar trend to the 'brain' example. Many of the contributors describe themselves as persons with some sort of disorder or condition, most commonly ADHD, generalized anxiety disorder, depression or what users call social anxiety. Some have been diagnosed and are either in pharmaceutical treatment or have been in the past, while others are self-diagnosed and self-medicate with both pharmaceuticals and other kinds of substances. Thus, their condition, whatever it is, is their main reason for wanting to use substances to enhance their wellbeing or everyday life. There are, however, equally many examples of anxiety, depression or lack of wellbeing in general in descriptions of the unwanted effects of the substance use, both among those who have never felt any of these conditions, and those who have some sort of problem to begin with. In these cases, where anxiety, for example, is experienced as a side effect of a substance, users talk about their experiences and ask whether other users have had similar reactions. They also ask for advice about other types of substances that might work as well but without the side effects. Several examples discuss a lack of wellbeing not as a direct side effect but as an effect of quitting a substance such as a prescription stimulant. One person, for example, describes an everyday life characterized by anxiety, lack of energy and a self-

diagnosed depressed state of mind, even many months after quitting stimulants, wondering if the stimulants have damaged the brain; it is also asked whether there are any substances that could provide energy and focus without the amphetamine on which stimulants are based and which are assumed to have caused the problems being experienced.

It is a common trend in these posts to blame stimulants for a problem specifically related to side effects, withdrawal symptoms and a relatively high price. Yet even among those who seem to have found the right substance or combination of substances (called a 'stack') and the right dosage, and where stress or anxiety have been reduced or dissolved and there are no unwanted effects, usage is still problematized. People query how long substance use should go on, whether they should keep using the substance forever and worry whether it will continue to work as well as it does at the moment. As one person writes, paraphrased here for purposes of anonymity; "*I'm not expecting enhancement at the level of the movie Limitless, but I am not sure nootropics are worth taking for months or years if the only effect is a small improvement in memory, skills and mood.*" The post ends by asking which nootropics have provided people with the greatest effects.

Managing effects

What is common of all the posts we have examined, indicated by the most common term in all of the texts, is the focus on effects. In this subreddit, users generally describe how they manage effects and essentially optimize their enhancement practices regardless of their motivation and starting point for wanting to engage in cognitive enhancement. Many of the posts, written by people who have little or no prior experience with these substances, request a range of information including how many milligrams to take, how to put stacks together and how often or in which kinds of situations it might be best to take them. Another common theme relates to when people experience no effects or the wrong effects, as we have seen from examples cited in the previous section. Again, here the posts often revolve around dosages and substance combinations but also conditions such as brain fog or anxiety; there are often specific descriptions of how users feel and what they do to overcome it. Then there are those who have stopped taking certain substances (most often prescription stimulants) and want to find a way to continue to engage with enhancement practices in what they often term 'a more natural way',

meaning through substances that are not controlled pharmaceuticals. A relatively common concern here is whether it is actually worthwhile taking substances for enhancement if either the side effects are too strong or the intended effects too weak. Interestingly, there are sometimes indications in these texts that it is a sensitive discussion in which people are afraid to be (mis)judged in relation to the general concept of enhancement through substances. This is exemplified by a post written by a college student who uses the stimulant Modafinil to enhance study skills and would like to talk about it with some of his fellow students. However, as he writes, here in a paraphrased version: "*I am afraid that they will think it is wrong to use a drug to get an advantage, or that they will tell the school personnel and it will have consequences for my studies.*" As we will show in the following section, which is based on ethnographic fieldwork among university students, talking about the negative effects of enhancement is indeed a sensitive topic.

An ethnography of untold stories

At the beginning of the semester in early September, study centers and campus libraries are more or less empty at the ethnography site in New York. As the semester progresses, study areas fill up and opening hours are extended. During December they are open 24 hours a day, 7 days a week. Students generally agree that at semester start there is not much work. Then the work pressure progressively builds up, making the finals period completely crazy, with piles of papers to read and write all at once. After final exams they go on break and do nothing, as they say, for however many weeks it lasts, and then it starts all over again with the onset of a new semester. Students generally use stimulants more frequently and at higher doses the further into the semester they get, although there is quite a variation in how often and in what situations they use them. When on break, most of the students in the study do not even think about stimulants, unless they need to catch up on work they did not finish or if, for example, an occasional apartment cleaning becomes too boring.

Students' stories of the increasing pace of their everyday lives and their temporarily escalating use of stimulants often gives the impression that stimulants work as a 'wonder-drug' that allows them fully to control their time and make the most of it; descriptions of tunnel vision and robotic tirelessness are common.

> When you take Adderall you become immersed in what you're doing. You
> don't care about anything else. And you just want to keep going and going
> and going. The more you progress the more interesting it gets. You become
> kind of like a robot performing the tasks that are difficult to do.
> (Parker, BA student)

However, as the semester progresses small differences appear between what students first said about their stimulant experiences and what in some instances occurs. Asked directly, most students say that they do not feel particularly tired or down the day after taking stimulants; however, as the semester progresses, they are often late for appointments, having overslept or because they are feeling exhausted due to 'last night's studying' even if our appointment is scheduled for late afternoon.

It also becomes evident that students are not always particularly focused or energized all the time or every time they use stimulants. Ben and his circle of friends sometimes take breaks and talk or watch music videos in the middle of the night even though it is an Adderall study session. In a conversation about it the day after, Ben explains, slightly flustered at being confronted with it:

> Well if I was a perfectly well-oiled machine then, yeah, I would never take a
> break but sometimes I just don't want to do it…[laughs]…sometimes to
> incentivize I take a break, talk about nonsense or whatever. My friend was just
> showing us a Beyoncé video; I couldn't care less about it but, you know, it
> was something else. (Ben, PhD student)

Ben has never in any previous interviews and conversations explained that it is not always easy to work on stimulants, and he is not proud of his occasional lack of focus or interest in doing productive work despite having ingested a substance in order to do it. On a different night, at around 3 a.m., Ben exclaims that he needs a break. When asked about it he admits that he is tired from working so hard, particularly on tasks he finds a waste of time, and he tells me that he cannot figure out if he should take another Adderall or lie down and sleep on the floor.

Another example is provided by Josh, a BA student who was on top of things throughout the semester and never had anything negative to say about stimulants except

that they sometimes spoiled his ability to have sex. Suddenly, in the last week of the semester, he did not show up for our appointment, two days after having turned in the final exam paper. He was going to return books and do some practical paperwork on campus, so we agreed to meet for a coffee near the library. 24 hours went by before he sent an email apologizing and saying that he had lost his phone, his wallet and his keys and had no way of getting in contact. Only after he had been asked several times and very directly about what had happened did he explain that he had crashed after two 'all-nighters' and a party, meaning three days without sleep. He was quite embarrassed and did not really want to talk much about it. However, a month before, he had had no trouble talking about being too drunk at a party and almost getting into a fight with someone. In his reflections after his 'crash', he does consider that using stimulants in this way may not be a viable solution in the long run:

> It's like the zeitgeist of our times, like get as much out of everything as possible always. So if I can stay up all night and then get a paper done and then go out the following night with my friends then in my mind I have beaten the system. I don't know how long I will be able to keep that up but it is just like…a prevailing feeling…it's New York too…like…maximize at all costs. (Josh, B.A. student)

Harrison, an otherwise strong believer in the productivity of stimulants, seemed to be full of doubt and negativity towards the end of the semester. Sitting in his apartment one afternoon in December, he says that he is not feeling productive at all, and that he is pissed off, because he has taken a stimulant and that it is a waste if it does not work.

> There are times where I wonder if stimulants do anything positive at all. Certainly superficially it would seem like they are, you have increased energy, this sort of intense connection, focus on the material, but at the higher doses, it starts to become slightly frantic…and if you're writing something very quickly, you have this sensation that you're being very productive and that you are enhanced as a worker, but just because you're writing quickly doesn't necessarily mean that you are writing more or of higher quality. (Harrison, MA student)

We talk about whether or not Harrison might want to stop using stimulants and he hesitates for a moment as he considers what to say.

> It's no question that I would, if possible like to stop taking stimulants. I would like to stop, but really the deciding factor is, do they make me better at working? And if the answer is yes, then it's something I'm willing to risk and willing to take on the burden of... in order to do more things. But if they don't then it's really stupid to be taking them. (Harrison, M.A. student)

Harrison finds it difficult to stop because, as time passes, more and more work has been done on a stimulant, and the idea of doing work when not on a stimulant becomes daunting. There is a constant hope, on his part, that the stimulant will work equally well every time. It is precisely the magical experiences of heightened intensity, focus and productivity, 'the sense of urgency and drama that comes when writing on a stimulant', as Harrison describes it, that keep alive the hope that the next stimulant work session will be just as good.

Though all these unproductive experiences and moments of doubt are very different in scope and character, what they have in common is that they are the less frequently revealed experiences of stimulant use. They are reflections that are not included when students are first asked why they use stimulants and how they experience them. They are experiences that are revealed in time, examples of the unplanned and uncontrollable aspects of stimulant use that mostly occur far into the semester. These less productive aspects of stimulants raise serious doubt and ambivalence in students because if there is a possibility that stimulants may slow down the work process instead of speeding it up, or if the time following what students often term, 'Adderall-time' is wasted or useless, then perhaps these enhancement practices only give the illusion of having the desired effects.

Discussion: Uncertain effects and the emergence of doubt

We have presented two very different data sets that each in their way shows that engaging in cognitive enhancement practices by no means always reflects the idealized stories, concern-free attitudes (A. D. DeSantis & Hane, 2010) and control over or belief in effects (M. Farah et al., 2014; Finger et al., 2013; Petersen et al., 2015; Schelle et al., 2014; Vrecko, 2013) that are often in the foreground of research on cognitive enhancement.

Comparing data sets

While the Reddit material contains a much more varied context in terms of substances and population than the ethnographic data, there are important similarities that suggest that the two populations might also be understood as part of the same 'community' in its widest meaning. As described earlier, the age range, gender distribution and cultural background of the two 'groups' are strikingly similar and while not all of the Reddit material connects to the educational realm, a significant number of the posts are written by people who identify themselves as university students. As it is not possible – and nor is it our purpose in this article – to make an exact comparison of the substance users from the two data sets, we instead focus on common features in terms of the discourse on enhancement practices, effects and unintended consequences. In both datasets we see the presence of a number of uncertainties that are generated in the attempt to enhance the self. There are the uncertainties connected with using the substances in the best way and right amount, and also in terms of how best to manage effects, to either experience a better effect, or to reduce unwanted side effects; yet there are also doubts about using substances for enhancement in the first place, about whether these substances actually work or only offer the illusion that they work. By combining the two data sets, then, we come to see that cognitive enhancement is a more complex process than seems to be currently understood, and that this is a more general finding beyond academic performance enhancement. It is interesting to note that while prescription stimulants are the most common substances used among the university students in the ethnographic data, the Reddit material suggests that users are trying to find alternatives to stimulants, accounting for the lesser focus on stimulants in the subreddit in general.

Negative experiences as sensitive topic

As our mixed method analysis suggests, it is not easy for users engaged in enhancement practices to talk openly about negative or unintended consequences of their substance use. As the ethnographic material reveals, only over time and through participating in the students' everyday lives did a few stories of otherwise unreported aspects of enhancement surface. At the same time, an abundance of data on the negative effects and unintended consequences of using substances for enhancement permeates the online forum on Reddit, suggesting both that people using these substances experience negative effects, and that they feel a need to discuss, share or investigate them with others. As

previous research has shown, online community platforms and forums are widely used to discuss sensitive or stigmatized topics such as health issues (e.g., Tanis, 2008) or illicit drug use (e.g., Murguía, Tackett-Gibson, & Lessem, 2007). The same tendency is illustrated by Reddit's offering an anonymous and safe place to discuss matters that are too sensitive and ethically complicated to speak about openly.

The imperative of enhancement

Both data sets show that those who use these substances for enhancement are attempting to manage their time, abilities and experiences in order to meet demands and goals in their everyday lives. The use of these substances can thus be understood, in Nikolas Rose's terminology, as a "technology of optimization", a way of controlling processes of the mind and body (Rose, 2007). In the attempt to improve concentration, motivation and wellbeing – as common examples from the literature on medical enhancement show (Elliot, 2003; Petersen et al., 2015; Vrecko, 2013; Weyandt et al., 2009) – uncertainties about effects and practices arise. Much as engaging with technologies such as screening tests to control illness and human lives generates new and unforeseen uncertainties rather than creating situations of stability and certainty (Jenkins, Jessen, & Steffen, 2005), engagement in enhancement practices turns the processes of molding, shaping and bettering the self into a never-ending project that can always be improved. Yet, as Nicolas Rasmussen's history of amphetamines reminds us, "the self we struggle to become, may be designed to meet the expectations of others" (Rasmussen 2008: 254). In other words, and as the ethnographic material in particular suggests, the stories of tunnel vision and robotic tirelessness are the 'correct' stories, in the students' minds as, with these stories, they substantiate the ethical grounds for engaging in enhancement practices. With the increasing responsibility placed on the individual to be successful and well (Martin, 2000), enhancement has become a moral imperative (Mamo, 2010) and a way of surviving. Our study both quantitatively and qualitatively goes beyond the established findings that students do not regard the use of substances for studying ethically wrong as long as they are used for a serious purpose (A. D. DeSantis & Hane, 2010; Petersen et al., 2014), as we find that users become unsure when this type of substance use blurs the lines between work and fun (Petersen et al., 2015), treatment and enhancement (Petersen et al., 2014) or when the effects are questionable. Thus, when

users start to talk about the uncertainties of effects, they simultaneously also question the very grounds for using these substances, whether they want to or not.

Conclusion

This study demonstrates that users' knowledge of substances ingested for cognitive enhancement is very complex. On the one hand, it is interesting how reluctant those who use these substances are to share knowledge on the negative side effects in traditional qualitative research designs; on the other, we see that those who use the semi-anonymous online forum on Reddit are more willing to share negative experiences. Even though this is a methodological finding, it also indicates that people who use substances for enhancement are uncomfortable with discussing negative effects among close peers who also engage in enhancement practices, as it becomes a way of questioning their delicate ethical acceptance of this kind of substance use. The complex relation with negative effects is even more interesting in light of the users' perceptions of themselves as enlightened and reflexive about their choices. The very use of substances for cognitive enhancement has to some degree already sidetracked official health information, as the substances are employed in a way that is in direct opposition to official health paradigms (Petersen et al., 2014). Instead, people who use substances for enhancement have developed an intricate 'folk pharmacology' (Southgate & Hopwood, 2001) and symptomology; in other words, they rely on their own and others' experiences with these substances and the issues they are meant to alleviate. This indigenous knowledge seems to have priority over official medical knowledge.

We see from the Reddit findings that the discussions on the subject are preoccupied with substance effects and that negative side effects are a constant but minority component of this discussion. The discourse on negative effects may be a consequence of the ethical perspective on the use of substances for enhancement that is particularly pronounced in the ethnographic part of our analysis. The findings from this study indicate that the underdeveloped notions of the 'dark sides' of using substances for cognitive enhancement may make people who engage in such practices less able to make informed choices about them. As Aikins has suggested, one of the biggest problems with prescription stimulants is that they work, or that users believe that they work (Aikins, 2011), and this may very well be applied to nootropics more generally. With so many

available and possibly conflicting messages about what works and what does not work, for whom and in what situations, the pursuit of attaining a better self through substance use may often involve a never-ending journey of uncertainty and doubt that questions the ethical grounds for engaging in such enhancement practices in the first place.

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