



King's Research Portal

DOI:

[10.1002/hup.2596](https://doi.org/10.1002/hup.2596)

Document Version

Peer reviewed version

[Link to publication record in King's Research Portal](#)

Citation for published version (APA):

Wadsworth, E., Drummond, C., Kimergård, A., & Deluca, P. (2017). A market on both 'sides' of the law: the use of the hidden web for the sale of new psychoactive substances. *Human Psychopharmacology : Clinical and Experimental*, 32(3), [e2596]. <https://doi.org/10.1002/hup.2596>

Citing this paper

Please note that where the full-text provided on King's Research Portal is the Author Accepted Manuscript or Post-Print version this may differ from the final Published version. If citing, it is advised that you check and use the publisher's definitive version for pagination, volume/issue, and date of publication details. And where the final published version is provided on the Research Portal, if citing you are again advised to check the publisher's website for any subsequent corrections.

General rights

Copyright and moral rights for the publications made accessible in the Research Portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognize and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the Research Portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the Research Portal

Take down policy

If you believe that this document breaches copyright please contact librarypure@kcl.ac.uk providing details, and we will remove access to the work immediately and investigate your claim.

A market on both 'sides' of the law: the use of the hidden web for the sale of new psychoactive substances

Elle Wadsworth^{1*}, Colin Drummond¹, Andreas Kimergård¹ and Paolo Deluca¹

. 1 National Addiction Centre, Institute of Psychiatry, Psychology & Neuroscience, King's College London, 4 Windsor Walk, London, SE5 8BB, UK

* Correspondence: Address as above, elle.wadsworth@kcl.ac.uk, 0207 848 0487

Key words: New Psychoactive Substances; Drug Supply, Cryptomarkets; Hidden Web; Psychoactive Substances Act, 2016.

[This publication arises from the project "CASSANDRA, (Computer Assisted Solutions for Studying the Availability aNd Distribution of novel psychoActive substances)" which has received funding from the European Union under the ISEC programme - Prevention of and fight against crime [JUST2013/ISEC/DRUGS/AG/6414].

Abstract

Objective

The hidden web is used for the anonymous sale of drugs, and with the UK Psychoactive Substances Act, 2016 implemented on May 26th 2016; it could increase as a platform for obtaining new psychoactive substances (NPS).

This study aims to describe the NPS market on the visible and hidden web pre-ban, and assess whether the hidden web is a likely place for the sale of NPS post-ban.

Methods

Data collection of 113 online shops took place in October 2015. Data collection of 22 cryptomarkets took place every two months from October 2015-16 as part of the CASSANDRA project.

Results

All online shops with a UK domain location sold NPS that were uncontrolled by the UK Misuse of Drugs Act, 1971 and closed after the ban. Of the cryptomarkets analysed, the total number of vendors selling NPS, number of substances, and listings advertised, all increased over the year. The majority of the NPS advertised on the hidden web were phenethylamines and cathinones, yet the majority of uncontrolled NPS were synthetic cannabinoids.

Conclusions

Vendors selling and availability of NPS increased over the 12 months of data collection. Potential displacement from the visible web to hidden web should be taken into consideration.

Introduction

The Internet has a major role in the sale and distribution of new psychoactive substances (NPS) (Hillebrand, Olszewski & Sedefov, 2010; Schmidt, Sharma, Schifano & Feinmann, 2011). However, the availability and movement of NPS from when they first appear on the market until they are controlled under international and/or national drug laws or disappear from the market is under researched. NPS are sold online, often passed off as 'research chemicals' and 'legal highs', in shops that can be accessed through ordinary search engines such as Google™ or Bing™. In 2013, there were found to be 651 online shops selling NPS that purportedly shipped to Europe (EMCDDA, 2011). Here, the products vary according to manufacturer's availability and/or legislation (Smith & Garlich, 2013). In addition to the supply on the visible web, NPS can be purchased on the hidden web, an online network that cannot be accessed by regular search engines, but only with encryption software, such as the Onion Router (Tor) (Tor Project, 2016). On the hidden web, drugs are sold through cryptomarkets, which are platforms that use anonymous cryptocurrencies and where users can leave reviews of vendors and the products (Barratt, 2012; Seddon, 2014; Van Hout & Bingham, 2014). Research shows that it is predominantly illicit controlled drugs and medicines which are purchased through this market (Barratt, Ferris, & Winstock, 2014; Caudevilla et al, 2016). However, it remains only a small portion of the overall drugs market (EMCDDA & Europol, 2016). One of the best-known cryptomarkets was Silk Road, which closed in 2013 (DEA, 2013). Since the closure, there is no obvious market leader and the hidden web now has a wide range of retailers (Van Buskirk, Roxburgh, Farrell, & Burns, 2014; Van Buskirk, Roxburgh, Bruno & Burns, 2015). Cryptomarkets can be unpredictable and close down with little notice causing instability in the market (Van Buskirk, et al., 2015). The UK has the highest number of vendors in Europe, and ranked second in the world (Kristy et al, 2016).

There is mixed evidence on the extent to which the Internet is used for purchasing NPS. The estimate from various studies in the UK and Europe, is that one in ten purchasers will buy

their NPS products online (European Commission, 2014; Home Office, 2014a). In a self-selected population in the Global Drugs Survey, it was found that in 2013/14, 22.1% of responders bought their NPS online (Winstock, 2014). There are benefits to both buyers and sellers who use the Internet for the sale of drugs, such as anonymity and the removal of face-to-face contact (Van Hout & Bingham, 2013). It is important to note that it is not only NPS for personal use that can be bought via the Internet, NPS can be bought in bulk and distributed further among social circles and street level drug dealers (EMCDDA, 2013).

With the increasing concern of the growth of the NPS market, the UK Government introduced the Psychoactive Substances Act, 2016 on the 26th May 2016. The Act controls all psychoactive substances (with some exemptions), that are not already controlled by UK's principal drug law the Misuse of Drugs Act, 1971 (UK Government, 2016), by prohibiting unlicensed supply and production. Possession under the Act is not an offence (except in a custodial institution).

NPS that are not controlled under drug laws are desirable to both the suppliers and users, such as experimentation and production without fear of incarceration (Brandt, Sumnall, Measham, & Cole, 2010). Once a substance is controlled by international and/or national drug laws, one study found that interest in that drug declines (Ledberg, 2015). Research has found that displacement of drugs from one supplier to another, for example from high-street retailer to street-level drug dealer, is reflective of its legal status (Sumnall, Evans-Brown, & McVeigh, 2011). This has been the case with mephedrone, where it transitioned from online and high-street retail suppliers to street level drug dealers once it became a class B drug under the Misuse of Drugs Act, 1971 (EMCDDA, 2013). The Psychoactive Substances Act, 2016 was implemented with the intent of reducing the supply of NPS from online and high-street retail shops, and thus removed two principal supply routes of NPS (Home Office, 2015). But it is possible that a displacement has occurred instead between the visible and the hidden web for the sale of NPS after the implementation of the Act with little or no reduction in overall supply. There is currently insufficient data to assess the potential impacts

of the Act. Further, research to date has not focused specifically on the availability of NPS on the cryptomarkets, especially during a time of policy change. This paper therefore aims to: i. describe the markets for NPS on the visible and hidden web up to seven months before the implementation of the Psychoactive Substances Act, 2016; ii. consider the impact of the Psychoactive Substances Act, 2016 on the supply of the NPS after implementation, through number of vendors and available substances.

Methods

The data collection both on the visible and hidden web were carried out by the first author (EW) between October 2015 and October 2016; that is seven months prior to the Psychoactive Substances Act, 2016 and five months after the implementation. The study is part of the CASSANDRA project (www.projectcassandra.eu).

Data collection on the visible web

The search for online retailers selling NPS were made throughout October 2015. Search engine's Google™ and Bing™ were used and various keywords were chosen to extract retailers including “buy” followed by “legal highs”; “research chemicals”; “bath salts”; “party pills”; or, “herbal highs” (table 1).

<INSERT TABLE 1 HERE>

For every keyword, the first five pages of results were used, and those in the English language were extracted. Data collected from the websites included: types of NPS sold; last update of website; the country of domain; countries of distribution; and whether the company sold wholesale.

Data collection on the hidden web

The data collection on the cryptomarkets took place over two days in each month in October, December (2015), February, April, June, August and October (2016). The cryptomarkets were accessed through Tor. The cryptomarkets that were included were those in the English

language, sold NPS, and had an open registration to all. The marketplaces are shown in table 2. Certain cryptomarkets closed before data collected commenced such as Abraxas. In addition, other cryptomarkets opened or expanded to sell NPS during the data collection. Some cryptomarkets were inaccessible during periods of data collection but not suggested to have closed completely such as DrD's Marketplace, which was not accessible for data collection in June and October 2016.

<INSERT TABLE 2 HERE>

Data were collected on each cryptomarket of NPS advertised that were visible to the researcher. Data collected were: Name of NPS (not including illicit drugs, human enhancement drugs or medicines), name of vendor, whether the vendor sold illicit controlled substances, and the countries of distribution. It should be noted that the frequency of the specific NPS advertised was determined by the number of vendors advertising and the number of listings of that product.

Available substances were categorised based on chemical structure into 9 categories (EMCDDA, 2015):

1. Dissociatives
2. Benzodiazepine analogues
3. Cathinones
4. Opioids
5. Phenethylamines
6. Piperazines
7. Synthetic cannabinoids
8. Tryptamines
9. Others/Unspecified

Analysis was conducted using SPSS Statistics version 22 using descriptive analyses in form of frequencies and means as appropriate.

Ethical considerations

The research was observational and did not involve interaction with either buyers or sellers. All users on cryptomarkets use screen names and are anonymous. Confidentiality measures applied to the dataset included storage in an online, password-protected computer and removal of screen pseudonyms, URLs, and country identifiers. The study was approved by King's College London PNM Research Ethics reference number: LRS-15/16-3084 as part of the CASSANDRA project.

Results

Shops on the visible Internet

A total of 113 shops selling NPS on the Internet were found in the English language. Substances were sold in different forms, some were powders, herbal incense or pellets, and some were in branded packages, such as 'Gogaine' or 'Charly Sheen'. The branded NPS tended to display a similar combination of substances in varying ratios. Only 13% of shops (n=15) sold all forms of NPS. Out of 113 shops monitored, party pills or pellets were the most common form of NPS and were sold in 81% of shops.

The online shops varied in the number of NPS that were sold, with a range of 180, and a mean of 37.5 (SD= 45.4) (when treating branded NPS as individual NPS).

Shops were explored to see whether in addition to individual sale, they also offered wholesale, selling large quantities at a lower price. A majority of 55% of websites sold wholesale, whereas the remaining websites did not advertise the option.

All substances sold on the visible web with a UK domain were not controlled under the Misuse of Drugs Act, 1971 at the time of data collection. They included but were not limited to: Mexedrone, 1P-LSD, 3F-Phenmetrazine, bk-2C-B, diphenidine, MDAI, and AB-CHMINACA. Substances that were pending control, such as methiopropamine (MPA), were advertised with a discount price and highlighted that 'all stock must go'. Shops appeared to

be aware of changes in legislation and remove substances that were pending control. The market seemed to respond by introducing new substances with similar effects.

Shops promoted new substances as alternatives of popular NPS. For example the following is a description of Mexedrone from the website RapidChems (rapidchems.com/en/):

“The result is a product that’s similar in effect to 4-MMC aka Mephedrone [controlled under the Misuse of Drugs Act, 1971]. It’s a bit weaker and a bit more material is needed for the desired result in your lab experiments but it’s clearly the most similar thing to MMC and we think the best product in its category right now.”

Of the 46 unique substances that were sold on the Internet online shops and from a domain location in the UK, 76% of substances were also sold on the hidden web. Online shops with a UK domain location closed prior to the implementation of the Psychoactive Substances Act, 2016, and after the 26th of May, only 57% (n=64) of the shops were still operational. In some cases shops notified customers of their pending closure, and in other cases they simply disappeared. The remaining shops were headshops or located overseas.

Cryptomarkets

Over the 12 months of data collection, 22 cryptomarkets were included. Over the course of the data collection, ten new marketplaces selling NPS opened and six were shut down, with suspicions of financial scams.

From conducting the snapshots in two month intervals, the marketplaces included differed from month to month (table 2). The cryptomarket with the highest number of vendors selling NPS was not stable in the initial months, however AlphaBay retained the lead since February (table 3). The total number of vendors selling NPS, the total number of substances (controlled), and listings advertised all increased over the 12 months (74.5%, 93.6% and 132.3% respectively). The total number of uncontrolled substances advertised increased in the months preceding the implementation of the ban (73.1% increase). The leading NPS category alternated between cathinones and phenethylamines.

<INSERT TABLE 3 HERE>

Similar to the marketing techniques used on the visible web, vendors on the cryptomarkets used popular drugs to promote new stock, both controlled and uncontrolled. The following example was from cryptomarkets Valhalla (valhallaxmn3fydu.onion) and described the NPS “4-LPT”:

“Dear Sirs, This is a new product developed as an alternative to A-PVP [controlled], a white powder, purity 99.8%, its effect is very good, but there is no market visibility, so now small sample sales, I believe it will quickly make you more satisfied than the a-PVP, about its structural formula, as a trade secret, being confidential, look forward to working with you.”

Discussion

NPS were advertised on both the visible and hidden web, and almost all unique substances sold on the visible web were also available on the hidden web. The number of NPS advertised had increased over 12 months of data collection on the cryptomarkets for substances that are both controlled and uncontrolled (up to 26th May 2016) by the UK Misuse of Drugs Act, 1971. The growth of the NPS market on the hidden web suggests that the platform was capable for the displacement of drugs from online shops and high-street retailers, once the Psychoactive Substances Act, 2016 was established.

A total of 113 shops in the English language were found on the visible web selling NPS in different forms, such as powders and pellets. Just over half of the online shops were selling substances at wholesale. Wholesale may point in the direction of further distribution, and displacement to the street level drug dealer and through social networks (Home Office, 2014c). All substances found on the visible web, that held a UK domain, were not controlled under the Misuse of Drugs Act, 1971 at the time of data collection. After the implementation of the Psychoactive Substances Act, 2016, the UK shops either closed down, or relocated

overseas (Wadsworth, submitted). This mirrors what was found in a Home Office report, that some types of suppliers keep within the law and remove substances once controlled (Home Office, 2014b). Before the 26th May 2016, on the hidden web up to 31% of individual NPS advertised were not controlled in the UK and the majority were synthetic cannabinoids. However, the majority of overall substances sold were phenethylamines and cathinones. This is potentially due to both phenethylamines and cathinones having generic legislation in the Misuse of Drugs Act, 1971 rendering the majority controlled (ACMD, 2010). Phenethylamines were not as frequently described in literature as a popular class of NPS, and the most popular class of compounds were synthetic cannabinoids and cathinones (EMCDDA, 2015; Papaseit, Farré, Schifano, & Torrens, 2014; Zawilska & Andrzejczak, 2015).

On both the online shops and cryptomarkets, NPS were promoted as alternatives to popular illicit controlled drugs, which mirror what was found in previous studies (Brandt, et al., 2010). However, perhaps once all substances are controlled (with exemptions) and hold the same offences except possession, users may prefer to revert back to the original controlled drug (EMCDDA & Europol, 2016). Research has shown that in free market conditions, many users will choose well-established drugs over NPS (Caudevilla, 2014; Caudevilla et al, 2016).

A general instability of the cryptomarkets was observed throughout the data collection period. Over the course of the 12 months covered in this study, six markets closed due to suspected “exit scams” and ten new markets opened or begun advertising NPS. This only included the markets within the inclusion criteria, suggesting that even more may have opened and closed. The instability may deter buyers and sellers (Van Buskirk, et al., 2016), however replacement markets appear quickly and therefore the overall market exhibits resilience (Soska & Christin, 2015).

Over a period of 12 months, there was an increase in the number of vendors selling NPS

and the number of unique NPS being advertised. The number of uncontrolled substances advertised increased until April 2016 where it plateaued. The use of cryptomarkets for the sale of NPS had increased substantially in this short amount of time. It further supports the suggestion that the hidden web is a growing market in an increasingly technology-advanced society. There is mixed evidence to how much the Internet, including the hidden web, are used to purchase NPS or drugs as a whole (European Commission, 2014; Winstock, 2014), but there is evidence to suggest its use is increasing amongst some drug-taking populations (Winstock, 2015). The hidden web is suited to specific populations such as the more tech-savvy (Aldridge & Décary-Hétu, 2014). As such, displacement will most likely not be complete, as accessing the hidden web requires more skill than the online shops on the visible web. Further, specific populations that use high-street retailers, such as the homeless, may not have access to a computer or cryptocurrencies in order to visit cryptomarkets. However, there is a platform on the hidden web that is capable for the displacement of NPS for those that can use it.

Future research should explore to what extent the NPS market is displaced to the hidden web, and if so, does it remain. Although the cryptomarkets are a small portion of the drugs trade, there is potential for its increase in use. A recent report by RAND Europe (Kristy et al, 2016) stated that the evolution of the use of cryptomarkets was one of incremental and not explosive change. It was also found that listings have increased at a faster rate than transactions, suggesting that so far demand has not matched up to drug availability. Using the hidden web brings many benefits for the supplier and buyer that cannot be done via street level drug dealers. Communication can be made through encrypted messages that makes it more difficult for law enforcement to intercept (Van Hout & Bingham, 2014). Distribution is more effective, the mail service can be maximised, which would reduce the need for human distribution (Walsh, 2011). The sheer number of cryptomarkets operating with a high turnover shows that there is a demand for this type of drug market (Broséus, et al., 2016).

LIMITATIONS

The number of online shops found in this study (n=113) is lower than the snapshots provided by the EMCDDA (n=651) (EMCDDA, 2011). However, the methods used in this study on used stores in the English language and capped the results at five pages in Google™ and Bing™ search engines, which did not capture less popular online stores or those that did not come up in the search using the key words. For an overview of NPS sold on the visible web, 113 online shops were found to be sufficient for this purpose.

Another limitation to this study is that the data taken from the cryptomarkets were from what was advertised and does not represent data on how much was sold of each individual substance and received by buyers. However, it can be presumed that if the product is advertised, there is at least some availability from vendors and sufficient demand from users, which is what this study focuses on. In addition, this study did not purchase NPS from the cryptomarkets or test their contents.

This study collected data at seven snapshots over a time period of 12 months; due to the inconsistency and instability of the cryptomarkets more frequent snapshots over a longer period of time are perhaps advantageous.

CONCLUSION

The cryptomarkets are an emerging source of sale for NPS. With the online sales on both the visible and hidden web holding a substantial portion of the market, NPS sold on the cryptomarkets should be monitored after the implementation of the Psychoactive Substances Act, 2016. Before the ban, up to 31% of monitored drugs in this study sold on the hidden web were uncontrolled in the UK, and the total number of vendors selling NPS, the total number of substances (controlled), and listings advertised all increased over this relatively short time frame (74.5%, 93.6% and 132.3% respectively). Regardless of these numbers, the demand and sales of NPS on the cryptomarkets are limited compared to 'classic' controlled drugs such as cannabis and MDMA (Caudevilla, 2014). Furthermore, in a

recent report by the EMCDDA it was suggested that the reason for the low sales was due to their availability over the visible web (EMCDDA & Europol, 2016). With the reduction of NPS sales on the visible web and headshops, at least in the UK, this further supports the need to closely monitor the impact of the UK's Psychoactive Substances Act, 2016 on the hidden web drug supply.

Acknowledgements

This publication arises from the project "CASSANDRA, (Computer Assisted Solutions for Studying the Availability aNd Distribution of novel psychoActive substances)" which has received funding from the European Union under the ISEC programme - Prevention of and fight against crime [JUST2013/ISEC/DRUGS/AG/6414].

Colin Drummond was partfunded by the NIHR Biomedical Research Centre at South London and Maudsley NHS Foundation Trust and King's College London, and the NIHR Collaboration for Leadership in Applied Health Research and Care South London. The views expressed are those of the authors and not necessarily those of the NHS, NIHR, or Department of Health.

References

- Advisory Council on the Misuse of Drugs (ACMD). (2010). Consideration of the cathinones. Retrieved 6 May 2016 from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/119173/acmd-cathinodes-report-2010.pdf
- Aldridge, J. & Décary-Hétu, D. Not an 'Ebay for Drugs': (2014). The Cryptomarket 'Silk Road' as a Paradigm Shifting Criminal Innovation. Social Science Research Network. Retrieved 1 July 2016 from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2436643.
- Barratt, M. J. (2012). Silk Road: eBay for drugs. *Addiction*, 107(3), 683-683.
- Barratt, M. J., Ferris, J. A., & Winstock, A. R. (2014). Use of Silk Road, the online drug marketplace, in the United Kingdom, Australia and the United States. *Addiction*, 109(5), 774-783.
- Brandt, S. D., Sumnall, H. R., Measham, F., & Cole, J. (2010). Analyses of second-generation 'legal highs' in the UK: Initial findings. *Drug testing and analysis*, 2(8), 377-382.
- Broséus, J., Rhumorbarbe, D., Mireault, C., Ouellette, V., Crispino, F., & Décary-Hétu, D. (2016). Studying illicit drug trafficking on Darknet markets: structure and organisation from a Canadian perspective. *Forensic science international*, 264, 7-14.
- Caudevilla, F. (2014). The importance of NPS in online drug markets: data from Silk Road 2.0. In *III International Conference on Novel Psychoactive Substances (NPS)*. Rome.
- Caudevilla, F., Ventura, M., Fornís, I., Barratt, M. J., Vidal, C., Ildanosa, C. G., Quintana, P., Muñoz, A., & Calzada, N. (2016) Results of an international drug testing service for cryptomarket users. *International Journal of Drug Policy*, doi: 10.1016/j.drugpo.2016.04.017.
- Drug Enforcement Agency (DEA). 2013. Manhattan U.S. Attorney Announces Seizure of Additional \$28 Million Worth of Bitcoins Belonging to Ross William Ulbricht, Alleged

- Owner and Operator of "Silk Road" Website. Retrieved 6 May 2016 from <http://www.dea.gov/divisions/nyc/2013/nyc102513.shtml>.
- EMCDDA. (2011). Online sales of new psychoactive substances/'legal highs': summary of results from the 2011 multilingual snapshots. Retrieved 6 May 2016 from <http://www.emcdda.europa.eu/publications/scientific-studies/2011/snapshot>.
- EMCDDA. (2013). EU drug markets report: a strategic analysis. Retrieved 30 Sept 2015 from <http://www.emcdda.europa.eu/publications/joint-publications/drug-markets>.
- EMCDDA. (2015). European Drug Report: Trends and developments. Luxembourg: Publications Office of the European Union.
- EMCDDA, & Europol. (2016). EU Drug Markets Report: In-Depth Analysis. Luxembourg: Publications Office of the European Union.
- European Commission. (2014). Flash Eurobarometer 401: Young People And Drugs. Retrieved 5/10/15 from http://ec.europa.eu/public_opinion/flash/fl_401_present_en.pdf
- Hillebrand, J., Olszewski, D., & Sedefov, R. (2010). Legal highs on the Internet. Substance use & misuse, 45(3), 330-340.
- Home Office. (2014a) Drug Misuse: Findings from the 2013/14 Crime Survey for England and Wales. Retrieved 2 Oct 2015 from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/335989/drug_misuse_201314.pdf.
- Home Office. (2014b). New psychoactive substances in England: a review of the evidence. Retrieved 30 Sept 2015 from <https://www.gov.uk/government/publications/new-psychoactive-substances-in-england-a-review-of-the-evidence>.
- Home Office. (2014c) New psychoactive substances review: report of the expert panel. Retrieved 30 Sept 2015 from <https://www.gov.uk/government/publications/new-psychoactive-substances-review-report-of-the-expert-panel>.
- Home Office. (2015). Impact Assessment: Creation of a blanket ban on new psychoactive substances in the UK. Retrieved 6 May 2016 from

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/433151/NPSGBImpactAssessment.pdf.

Kristy, K., Aldridge, J., Décarry Héту, D., Sim, M., Dujso, E., & Hoorens, S. (2016). Internet-facilitated drugs trade: An analysis of the size, scope and the role of the Netherlands. Santa Monica, CA: RAND Corporation.

http://www.rand.org/pubs/research_reports/RR1607.html.

Ledberg, A. (2015). The interest in eight new psychoactive substances before and after scheduling. *Drug and alcohol dependence*, 152, 73-78.

Papaseit, E., Farré, M., Schifano, F., & Torrens, M. (2014). Emerging drugs in Europe. *Current opinion in psychiatry*, 27, 243-250.

Schmidt, M. M., Sharma, A., Schifano, F., & Feinmann, C. (2011). "Legal highs" on the net—Evaluation of UK-based Websites, products and product information. *Forensic science international*, 206, 92-97.

Seddon, T. (2014). Drug policy and global regulatory capitalism: The case of new psychoactive substances (NPS). *International Journal of Drug Policy*, 25, 1019-1024.

Smith, S. W., & Garlich, F. M. (2013). Availability and Supply of Novel Psychoactive Substances. In P. Dargan & D. Wood (Eds.), *Novel Psychoactive Substances: Classification, Pharmacology and Toxicology* (pp. 55-77). London: Academic Press.

Soska, K., & Christin, N. (2015). Measuring the longitudinal evolution of the online anonymous marketplace ecosystem. In *24th USENIX Security Symposium*. Washington, D.C.

Sumnall, H. R., Evans-Brown, M., & McVeigh, J. (2011). Social, policy, and public health perspectives on new psychoactive substances. *Drug testing and analysis*, 3, 515-523.

Tor Project. The Tor Project. Retrieved 9 May 2016 from <https://www.torproject.org/>.

UK Government. Psychoactive Substances Act 2016. Retrieved 9 May 2015 from <http://www.legislation.gov.uk/ukpga/2016/2/contents/enacted>.

- Van Buskirk, J., Roxburgh, A., Farrell, M., & Burns, L. (2014). The closure of the Silk Road: what has this meant for online drug trading? *Addiction*, 109, 517-518.
- Van Buskirk, J., Roxburgh, A., Bruno, R., and Burns, L. (2015). *Drugs and the Internet*, Issue 5, October 2015. Sydney: National Drug and Alcohol Research Centre.
- Van Buskirk, J., Roxburgh, A., Bruno, R., Naicker, S., Lenton, S., Sutherland, R., Whittaker, E., Sindicich, N., Matthews, A., & Butler, K. (2016). Characterising Dark Net Marketplace Purchasers in a Sample of Regular Psychostimulant Users. *International Journal of Drug Policy*. <http://dx.doi.org/10.1016/j.drugpo.2016.01.010>.
- Van Hout, M. C., & Bingham, T. (2013). 'Silk Road', the virtual drug marketplace: A single case study of user experiences. *International Journal of Drug Policy*, 24, 385-391.
- Van Hout, M. C., & Bingham, T. (2014). Responsible vendors, intelligent consumers: Silk Road, the online revolution in drug trading. *International Journal of Drug Policy*, 25, 183-189.
- Wadsworth, E., Drummond, C., & Deluca, P. (2016). The adherence to UK legislation by online shops selling new psychoactive substances. (*Manuscript submitted for publication*).
- Walsh, C. (2011). Drugs, the Internet and change. *Journal of psychoactive drugs*, 43, 55-63.
- Winstock, A. (2014) The Global Drug Survey 2014 findings. Retrieved 5 Oct 2015 from <http://www.globaldrugsurvey.com/facts-figures/the-global-drug-survey-2014-findings/>.
- Winstock, A. (2015). The Global Drugs Survey Findings 2015. Retrieved 22 Jul 2016 from <https://www.globaldrugsurvey.com/the-global-drug-survey-2015-findings/>
- Zawilska, J. B., & Andrzejczak, D. (2015). Next generation of novel psychoactive substances on the horizon—A complex problem to face. *Drug and alcohol dependence*. 1, 1-17.

Table 1: The number of online shops found under each key words on search engine's Google™ and Bing™.

Key word (Buy +)	Number of online shops
Legal highs	25
Research chemicals	35
Bath salts	10
Party pills	24
Herbal highs	19
TOTAL	113

Table 2: Number of vendors selling NPS in each cryptomarket from October 2015 to October 2016.

Cryptomarkets	Number of vendors						
	Oct	Dec	Feb	Apr	Jun	Aug	Oct
	2015	2015	2016	2016	2016	2016	2016
Abraxas	88	CLOSED	-	-	-	-	-
Nucleus	67	84	86	92	CLOSED	-	-
Middle Earth	51	CLOSED	-	-	-	-	-
Alphabay	44	83	96	122	134	157	244
Valhalla	21	28	34	31	37	49	50
Dream Market	16	67	67	35	111	117	120
East India Company	11	24	CLOSED	-	-	-	-
CryptoMarket/SR3	5	15	14	17	15	14	15
HANSA	5	7	10	11	26	27	41
DrD's Market	3	6	12	15	DOWN	13	CLOSED
OUTLAW	3	9	5	3	5	7	5
Python Market	2	5	8	9	8	8	DOWN
Acas	-	4	11	CLOSED	-	-	-
TheRealDeal	-	1	2	5	5	7	DOWN
Oasis	-	-	4	1	8	14	DOWN
Apple	-	-	-	7	7	10	11
T*cka	-	-	-	3	5	8	7
Detox	-	-	-	2	4	3	5
Leo	-	-	-	-	4	5	8
Acropolis	-	-	-	-	2	3	4

Minerva	-	-	-	-	-	2	DOWN
TradeRoute	-	-	-	-	-	-	6

Table 3: Summary of descriptives of the cryptomarkets

	Oct 2015	Dec 2015	Feb 2016	Apr 2016	June 2016	Aug 2016	Oct 2016
ALL NPS							
Cryptomarket leader (no. of vendors selling NPS)	Abraxas (88)	Nucleus (84)	AlphaBay (96)	AlphaBay (122)	AlphaBay (134)	AlphaBay (157)	AlphaBay (244)
Total no. of vendors selling NPS	212	214	233	256	262	307	370
Total no. of unique NPS advertised	94	119	158	161	163	169	182
Total no. of vendors selling NPS alone or with prescription drugs	107	98	88	108	95	114	138
Total no. of NPS listings	759	840	958	1187	1311	1322	1763
Leading NPS category	Phenethylamines	Cathinones	Phenethylamines	Cathinones	Phenethylamines	Cathinones	Cathinones
UNCONTROLLED (% of total number of NPS)							
Total no. of NPS sold	26 (27.7)	37 (31.1)	46 (29.1)	45 (28.0)	N/A	N/A	N/A
Total no. of NPS listings	142 (18.9)	185 (22.0)	243 (25.4)	303 (25.5)	N/A	N/A	N/A
Leading NPS category	Synthetic cannabinoids	Synthetic cannabinoids	Synthetic cannabinoids	Synthetic cannabinoids	N/A	N/A	N/A

“Uncontrolled” substances are those not controlled under the UK Misuse of Drugs Act, 1971, before the implementation of the Psychoactive Substances Act, 2016 on the 26th of May 2016.