



Forensic drug intelligence and the rise of cryptomarkets. Part II: Combination of data from the physical and virtual markets

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ABSTRACT

Technology provides new ways to access customers and suppliers while enhancing the security of off-line criminal activity. Since the first cryptomarket, *Silk Road*, in 2011, cryptomarkets have transformed the traditional drug sale by facilitating the creation of a global network of vendors and buyers. Due to the fragmented nature of traces that result from illegal activities, combining the results of concurrent processes based on traces of different nature should provide supplementary benefit to understand the drug market.

This article compares the data of the Australian virtual market (in particular data extracted from cryptomarkets) to the data related to traditional market descriptors, namely national seizures and arrests, prevalence data, shipping countries of seized post shipments as well as outcomes of specific surveys targeting users' behaviour online. Results revealed the domestic nature of the online illicit drug trade in Australia which is dominated by amphetamine-type substances (ATS), in particular methylamphetamine and cannabis. These illicit drugs were also the most seized drugs on the physical market.

This article shows that the combination of different information offers a broader perspective of the illicit drug market in Australia and thus provides stronger arguments for policy makers. It also highlights the links between the virtual and physical markets.

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1. Introduction

Illicit drug markets are highly dynamic, adaptable and innovative. They are driven by business considerations, globalisation, technological developments and changes in law enforcement activities as illustrated by the recent rise of *darknet* marketplaces [1]. A previous paper characterised the Australian virtual market through the analysis of two major cryptomarkets at the time of their activity (*Evolution* and *Silk Road 2*) [2]. Particularly, it intended to compare the Australian trade with the international trade, explain the online supply side in terms of substances offered and prices, the online demand side using feedback and finally the role that cryptomarkets play in the distribution chain using the mass of illicit drugs offered.

The findings showed that, compared to countries such as the Netherlands or the United Kingdom, Australia's trafficking on *Evolution* and *Silk Road 2* was mainly domestic [2]. Several factors were raised to explain this trend, such as the geographic isolation of Australia, the tighter control at borders preventing vendors from selling to Australia, the higher price range of illicit drugs in Australia (i.e. Australian-based vendors do not need to sell internationally to be profitable) or the high number of clandestine laboratories detected in Australia resulting in domestic production of the most offered substances on cryptomarkets [3]. The supply and demand sides of the Australian virtual market were characterised by the predominance of vendors and listings of methamphetamine on both *Evolution* and *Silk Road 2*, at levels higher than the international trend. This observation seems to characterise the Australian market and will be investigated further in the present article.

Illicit drug trafficking is a complex problem that requires the systematic exploitation of crime traces combined with alternative information to obtain the most complete possible picture of the

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market [4]. In Australia, there are a number of approaches to obtain information regarding illicit drug use and trafficking, e.g. self-report survey known as the National Drug Strategy Household Survey (NDSHS) [5]; the Illicit Drug Reporting System (IDRS) [6,7]; the Ecstasy and Related Drugs Reporting System (EDRS) [8,9]; the Illicit Drug Data Report (IDDR) [10,11]; and more recently waste water analysis [12,13].

The NDSHS is conducted every three years [5]. It is a nationwide survey targeting households that aims to obtain an estimation of the number of people that consume alcohol, tobacco and illicit drugs in Australia. The households are selected in a multistage, stratified area random sample and a drop and collect strategy is used [5]. The NDSHS collects information of people aged 12 or older across Australia on their consumption. The survey is based on households, thus institutional settings, hostels, motels or homeless people are not included. The Illicit Drug Reporting System (IDRS) is a national illicit drug monitoring system based on interviews of people who regularly inject drugs, interviews with key experts and data sources related to illicit drugs [6,7]. Similarly, the Ecstasy and Related Drugs Reporting System (EDRS) utilises surveys from a sentinel group of regular psychostimulant users to monitor trends in drug use [8,9]. Participants are recruited through a purposive sampling strategy (i.e. through advertisements and 'snowball' procedure¹) and they have to have used illicit drugs on a monthly basis at least. The Illicit Drug Data Report (IDDR) presents data from different sources, in particular law enforcement agencies and health [10,11]. It records the number of national seizures and arrests every year. More recently, the Australian Criminal Intelligence Commission [13] published a report about a national wastewater drug monitoring program (NWDMP) to monitor drug consumption through wastewater analysis. Fifty-one sewage treatment plants, including sites in capital cities and rural areas were analysed. Finally, in 2013, the Australian Federal Police (AFP) launched the National Forensic Rapid Lab (NFRL). The NFRL targets low volume but high frequency drug importations into Australia, typically parcel-post seizures. The team working in the Rapid Lab triages all packages internationally sent into Australia and extracts relevant information, such as fingerprints, handwriting, chemical identification of the drug and shipping country [14]. Unlike the other data sources discussed above, NFRL data is not publicly available and was provided by the AFP for the purpose of this study.

Separately, these sources, as well as the information that can be extracted from cryptomarkets, only reflect a small part of the drug problem and are usually incomplete as a sole descriptor of illicit drug markets. As a consequence, combining the results of concurrent processes based on traces of different nature would provide supplementary added value [15,16]. The aim of this article is to compare the data of the Australian virtual market to data related to traditional market descriptors, namely national seizures and arrests, prevalence data, shipping countries of seized post shipments as well as outcomes of specific surveys targeting users' behaviour online. Combining these approaches enable studying whether cryptomarkets are an extension of the traditional market or a completely separated market. Indeed, the domestic nature of the Australian virtual market is "ideal" to investigate if the physical and virtual markets are separated or connected and to what extent.

2. Method

2.1. Cryptomarkets data

The methodology utilised to collect, extract, structure, classify and analyse the data from cryptomarkets was thoroughly described in Part I [2]. In short, publicly available HTML source code pages of two marketplaces, *Evolution* and *Silk Road 2*, collected by Gwern Brawnen² were used in this study [17]. The period investigated covered December 2013 to November 2014 for *Silk Road 2* and January 2014 to March 2015 for *Evolution*. Sale proposals were semi-automatically reclassified according to a list of keywords that can be found in [18]. In total, 679 vendors and 17,304 listings for *Silk Road 2* and 2372 vendors and 42,933 listings for *Evolution* were identified. An analysis of shipping and destination countries was performed on both cryptomarkets. The number of vendors, listings and feedback on *Silk Road 2* only³ were used to obtain an indication of the supply and demand on this cryptomarket.

2.2. Traditional illicit drug market descriptors

Different sources of data reporting the characteristics of the physical market were used in this study. They are summarised in Table 1. These sources were investigated to obtain an understanding of the consumption and distribution of illicit drugs in Australia.

Our study also relied on data from seizures of packages made by the AFP through the NFRL from January 2014 to March 2015. The seizures were semi-automatically re-classified according to the same list of keywords that was used for the classification of sale proposal on cryptomarkets. For each seizure; the sender country; the recipient State; the drug weight; the drug type and the concealment method were recorded.

Analysis was performed using R[®] (The R Foundation for Statistical Computing, version 2.15.1), RStudio v. 1.0.136 and Tableau Software Professional Edition v. 10.4. Analysis was conducted on both cryptomarkets and NFRL data to evaluate the trafficking trends, in particular the most common sending countries, the most seized drug types and the most common masses sent and seized.

3. Results and discussion

3.1. Cryptomarkets overview

Key characteristics of the virtual Australian market were presented in Part I [2] through the analysis of *Evolution* and *Silk Road 2*, two important cryptomarkets during their time of activity [19,20]. It was shown that Australian vendors mainly offer illicit drugs to customers living in Australia, irrespective of the type of illicit drugs. Indeed, only a small number of foreign vendors seem to be ready to ship their products to Australia (as shown in Table 2).

Fig. 1 summarises the types of illicit drugs offered by Australian vendors and purchased (using the number of feedback) by customers on *Silk Road 2*. Since 95.7% of listings shipped from Australia are intended to Australia on *Silk Road 2*, it is hypothesised that the proportions presented in Fig. 1 reflect the Australian online offer and demand in illicit drugs at the time *Silk Road 2* was active.

² Gwern Brawnen released online one archive file, containing raw data for each cryptomarket, via a Reddit forum on the 19th of March 2015 with the indexed and compiled HTML source code pages (data downloaded on the 30th of April 2015 on <https://reddit.com/2zllmv>).

³ Pages recording the number of feedback per listing was not crawled for *Evolution*. As a result, the number of feedback per listings was not available on *Evolution*.

¹ A snowball procedure is widely used to access illicit drug users which are usually hidden. It relies on peer referral and consists on recruiting future subjects through acquaintances of previous subjects [9].

Table 1
Traditional illicit drug market descriptors.

Data source	Ref.	Dataset	Date targeted
The National Drug Strategy Household Survey (NDSHS)	[5]	Household survey: 23,855 people aged 12 or older	31 July–1 December 2013
Illicit Drug Reporting System (IDRS)	[6,7]	Interviews with 898 participants who regularly inject drugs (PWID) aged 16 or older	June–July 2014
Ecstasy and Related Drugs Reporting System (EDRS)	[9]	Interviews with 800 regular psychostimulant users who use ecstasy or illicit psychoactive substances/stimulants on a monthly basis at least	July and October 2014
Illicit Drug Data Report (IDDR)	[10,11]	States/Territories and national illicit drugs seizures (93,086) and arrests (112,049)	2013–2014
Wastewater analysis	[12,13]	Analysis of wastewater in 51 sewage treatment plants, including sites in capital cities and rural areas were analysed	2016
National Forensic Rapid Lab (NFRL)	[14]	Analysis of 4472 postal seizures of illicit drugs	January 2014–March 2015

Table 2
Flow of illicit drugs where Australia is listed either as a shipping or/and destination country on *Silk Road 2* and *Evolution*.

Shipping country	Destination country	Listings (%)	
		<i>Silk Road 2</i>	<i>Evolution</i>
Australia	Australia	95.7	53.8
Australia	Undeclared ^a	–	39.6
Australia	Worldwide	3.7	4.2
Worldwide	Australia	–	1.3
United States	Australia	0.2	0.5
Italy	Australia	–	0.2
Australia	List of specific countries	–	0.1
Australia	New Zealand	–	0.1
Austria	Australia	–	0.1
Colombia	Australia	–	0.1
Undeclared	Australia	0.4	–
Netherlands	Australia	0.1	–
Total		100	100

^a No shipping country or shipping destination were selected and was recorded as “undeclared”.

Amphetamine-type-substances (ATS), in particular Ecstasy & MDMA and methamphetamine, and cannabis dominate the virtual market based on the number of vendors, listings and feedback.

According to a study conducted by Barratt et al. [21] using the Global Drug Survey between 9 November 2014 and 3 January 2015, 6.4% of reported cryptomarkets users declared accessing drugs only through cryptomarkets, ranging from 10% in the United States to 4% in Australia. This percentage could be higher according to the American Federal Bureau of Investigation (FBI) documents where Australian customers were determined to be overrepresented relative to Australia's population [22]. Although the Australian sample size was limited to psychostimulant users, Van Buskirk et al. reported that almost 70% of cryptomarkets' purchasers ordered from vendors outside of Australia [22]. This is interesting given the domestic nature of the trafficking that we observed on *Evolution* and *Silk Road 2*. Listings and feedbacks are only the visible part of cryptomarkets; there are other structures such as direct sales that are not visible in our dataset (e.g. stealth listings [23]). Furthermore, a percentage of vendors either selects “Undeclared”, “Worldwide” or does not specify any shipping or destination country. Australian vendors or buyers may still be represented in these categories. As a result, it is important to investigate other data sources.

3.2. Australian illicit drug market through the traditional market descriptors

Fig. 2 represents a summary of the results obtained through the traditional sources of information of the Australian drug market. In order to be consistent with the period covered by cryptomarkets' data, the year 2014 was considered for the analysis (when available).

Six categories of illicit drugs were selected (i.e. cannabis, ATS (i.e. amphetamines and methamphetamines), ecstasy & MDMA, cocaine, heroin and New Psychoactive Substances (NPS)).

The IDRS, EDRS and NDSHS mainly inform on the demand (i.e. consumption). In the 2013 NDSHS (Fig. 2c), methamphetamine/amphetamine was reported as the third most commonly used illicit drug, after cannabis and MDMA. According to the interviews in the IDRS (Fig. 2a), the main illicit drugs used were cannabis, methamphetamine and heroin. In the EDRS (Fig. 2b), the main drug consumed by regular psychostimulant users is MDMA, followed by cannabis and methamphetamine. These two surveys target different groups of people who consume specific illicit drugs and therefore the differences observed in the proportions of certain illicit drugs are due to the targeted population. More recently, a supplementary method based on wastewater-based epidemiology has been proposed to better monitor and understand illicit drug use in Australia [12,13,24]. In these studies, cannabis was not targeted for analytical reasons. Of the drugs targeted, methamphetamine (i.e. ATS) was the most commonly detected and consumed drug in Australia (based on back calculation), followed by cocaine and MDMA. This is slightly different from the results of the NDSHS and EDRS surveys, where methamphetamine only comes third, after cannabis and MDMA. It is currently not possible to know if a few people consume many doses of particular illicit drugs or many people consume a few doses. Surveys focus on the consumers while wastewater-based epidemiology focuses on the overall consumption. This different focus as well as the different timeframe of both studies could explain the discrepancy observed between surveys and wastewater-based epidemiology. It is also important to highlight the weekly pattern of consumption of certain illicit drugs. In their Australian nationwide wastewater study, Lai et al. [12] observed a significantly higher use of cocaine and MDMA during the weekends in comparison to weekdays. In contrast, methamphetamine use was relatively stable throughout the week. The higher percentage of self-reported use of MDMA in comparison to methamphetamine could simply reflect the recreational use of this drug. Indeed, according to the NDSHS 2013 and 2016 [5,25], cannabis and methamphetamine users were more likely to use these drugs on a regular basis while cocaine and MDMA use was more infrequent.

The IDDR arrests (Fig. 2d) and seizures (Fig. 2e) mainly reflects the distribution and police activities. In 2013–14, the majority of drug seizures and arrests were related to cannabis followed by ATS. Furthermore, 744 clandestine laboratories were detected during this reporting period, the majority manufacturing ATS (excluding MDMA). Finally, Fig. 2f represents the percentage of illicit drugs seized and analysed by the NFRL. Ecstasy & MDMA and ATS were the most common seized illicit drugs through parcel post. Characteristics of the NFRL data will be further discussed in Section 3.4.

In summary, these sources of information are trying to understand an activity that seeks to remain undetected [15].

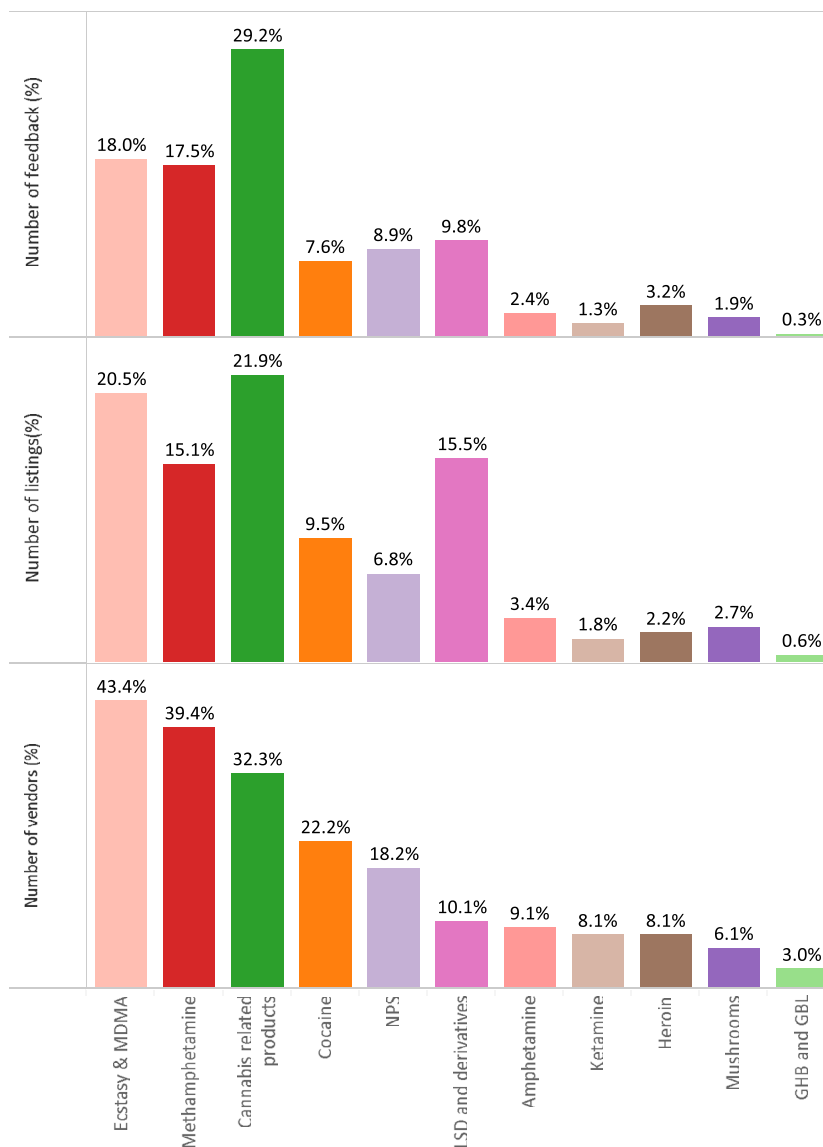


Fig. 1. Percentage of vendors, listings and feedback per type of illicit drugs on *Silk Road 2* (for Australia as a shipping country) (figure adapted from Fig. 9 in Ref. [2]). In this research, new psychoactive substances (NPS) include substances in the nine groups defined by The United Nations Office on Drugs and Crime (UNODC).⁴

Consequently, some limitations exist. Surveys are usually self-reported, voluntary, target specific sub-populations and users often do not have full knowledge of the drug they consumed, leading to some bias when interpreting the results. Data related to police efforts (illicit drug seizures and arrests) depend on law enforcement activities and might not be representative of the actual trafficking of illicit drugs. For example, law enforcement efforts may be oriented towards a specific illicit drug to disrupt its market during a certain time, leading to an increase of seizures of this particular drug type [16]. This results in an over-representation of seizures of that particular drug during that time. In regards to wastewater analysis, analytical difficulties are encountered due to the unknown pharmacokinetics of certain substances (e.g. NPS) and the instability of others (e.g. tetrahydrocannabinol (THC) or some of its metabolite). Despite the different uncertainties related to all these sources of information and the different targeted populations, as a general trend, cannabis seems to be the most consumed and distributed illicit drug in Australia, followed by ATS (primarily methamphetamine and MDMA), cocaine and NPS.

3.3. Combination of data from the virtual and physical markets

The cryptomarket analysis showed that although MDMA and methamphetamine were the most common drugs offered by vendors on *Silk Road 2*, cannabis was the most sold in Australia which is in line with the observations made using the traditional data source ([2] and Fig. 2). In regards to the high number of vendors, listings and feedback of LSD and derivatives on *Silk Road 2* (see Fig. 1), it is difficult to say whether this is a characteristic of the Australian market or a characteristic of *Silk Road 2* in particular. Indeed, a higher proportion of lysergic acid diethylamide (LSD) and derivatives on *Silk Road 2* was highlighted in comparison to other cryptomarkets [2,19]. According to the EDRS data [9] (data not shown in Fig. 2), 41% of participants declared having consumed LSD in the six months preceding the survey, ranking fifth in the illicit drugs reported being consumed (after MDMA, cannabis,

⁴ <https://www.unodc.org/LSS/SubstanceGroup/GroupsDashboard?testType=NPS>.

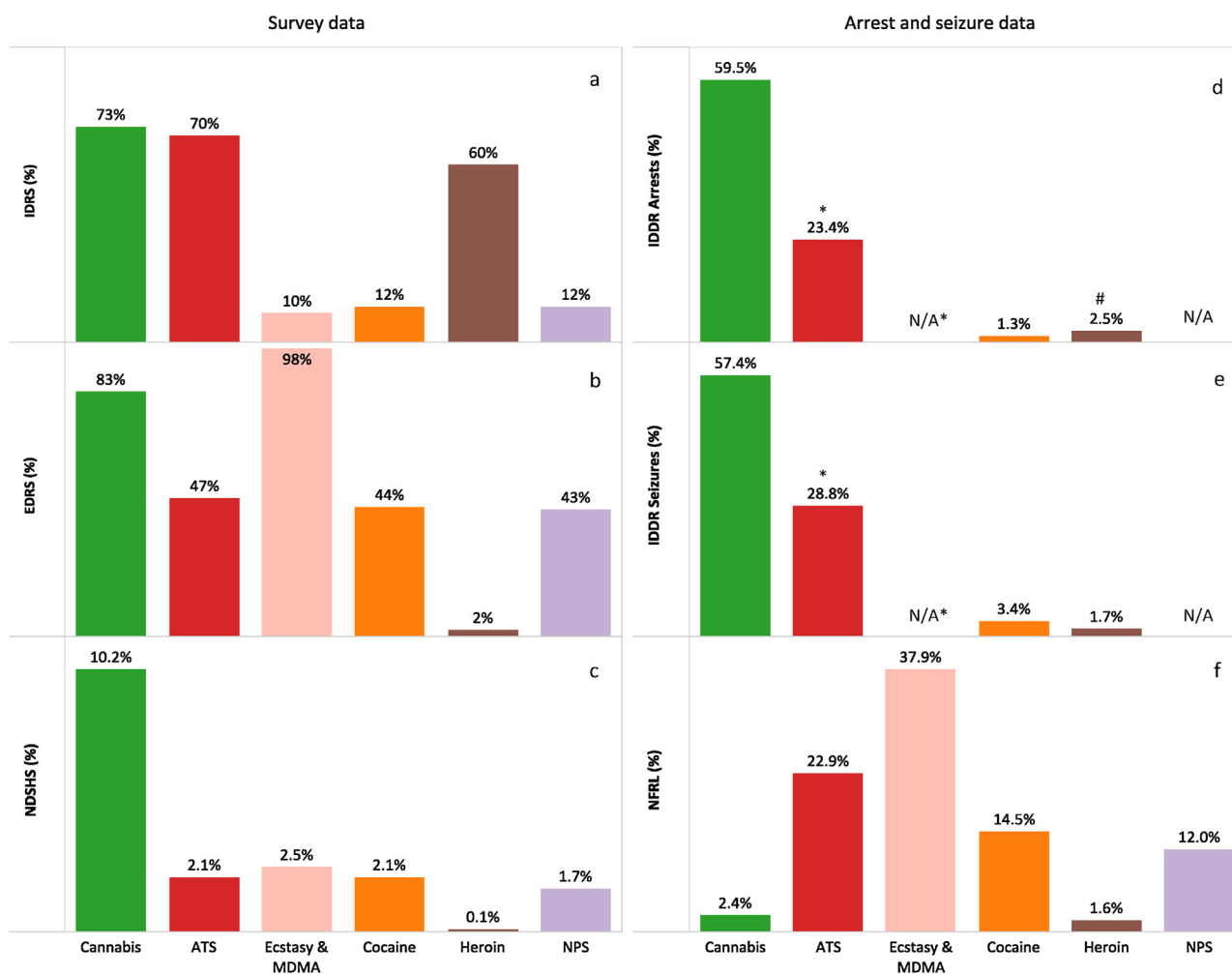


Fig. 2. Australian data coming from the three surveys representing the percentage of respondents (a–c), and the percentage of arrests (d) and seizures (e and f) related to a specific type of illicit drug. For better clarity, the vertical scale is different for each data source. N/A: the data were not available for that specific category; *In the IDDR, ATS comprised both amphetamines and phenethylamines (e.g. Ecstasy & MDMA); # the percentage (2.5%) comprised heroin and other opioids (e.g. methadone, pethidine, codeine, morphine and opium).

methamphetamine and cocaine). As a result, it might be a characteristic of the Australian market related to this specific group of people. To properly investigate this trend, the sale volume should be estimated but this was out of the scope of this article.

There seems to be a link between the physical and virtual markets. It is, however, difficult to know if this link is due to the domestic nature of the online trade (resulting in the sale of products that are domestically in demand) or whether it is due to the domestic consumption patterns (i.e. consumption of methamphetamine, MDMA, cannabis rather than cocaine and heroin). According to a recent study that investigated the position of cryptomarkets in the global supply chain of cannabis, heroin and cocaine, cryptomarkets provide a novel form of retail distribution for particular consumer countries rather than removing or replacing prior supply chains [26]. It is thus more likely that the link between the virtual and physical market is due to the domestic consumption patterns in Australia. The similarity between physical and virtual trade was also noticed by Demant et al. [27]. However, as mentioned in previous studies [28–30], cryptomarkets might be used by a sub-group of the Australian population, in particular recreational consumers or *psychonauts*.

Finally, as observed in Table 2, on *Evolution*, 2.2% of listings were shipped to Australia from other origin countries. On *Silk Road 2*, 0.6% of listings were sent from other countries to Australia. Since

the Australian drug market prices are relatively high [2], it can be hypothesised that international vendors are likely to sell illicit drugs through other online means. For this reason, the next section will focus on the NFRL data.

Table 3
Proportions of NFRL seizures made from January 2014 to March 2015 according to the type of illicit drug.

Illicit drug	Proportions (%)
Ecstasy & MDMA	37.9
Methamphetamine	14.7
Cocaine	14.5
NPS	12.0
Amphetamine	7.4
Other ^a	3.6
LSD and derivatives	2.5
Cannabis	2.4
Heroin	1.6
Ketamine	1.2
GHB and GBL	1.2
Other ATS ^b	0.8
Mushrooms	0.1

^a Other includes any illicit drugs that is not elsewhere classified.

^b Other ATS includes 3,4-methylenedioxy-N-ethylamphetamine (MDEA), 3,4-methylenedioxyamphetamine (MDA) and 2,5-dimethoxy-4-methylamphetamine (DOM).

Illicit drugs - AFP Seizures

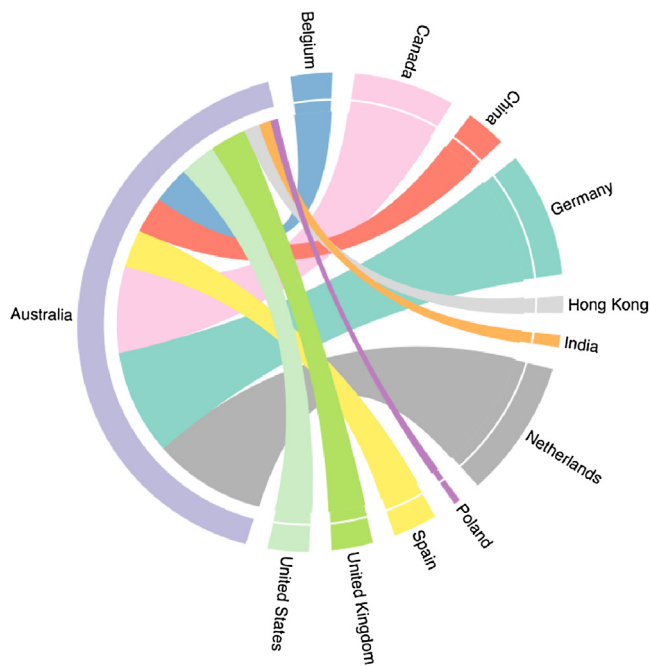


Fig. 3. Flows of illicit drugs using the NFRL data. The origins and destination (i.e. Australia) of illicit drugs are represented by the circle's segments. Specific colours are assigned to the flows and circle's segments of a particular country. The size of the flow is indicated by the width of the link and its basis. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

3.4. The National Forensic Rapid Laboratory (NFRL)

3.4.1. Type of illicit drugs seized by the NFRL

Part of the listings proposed to Australian buyers is sent from other countries that are sometimes referred to as “Undeclared” and

“Worldwide”. In addition, part of the trafficking is done through other online hidden channels that might not be reflected in the analysis of cryptomarkets. Finally, illicit drugs sold on cryptomarkets have to be physically sent and received by consumers. The national and international mail streams mark the intersection between the virtual and physical world [14]. The examination of intercepted mail is thus an important process to make the link between these two worlds. There is no certainty that the seizures made through the NFRL are linked to cryptomarkets. However, according to Horne et al. [14], up to 75% of all mail items detected by the Australian Customs and Border Protection Service and processed through the NFRL were suspected to be purchased online.

According to Table 3, MDMA is the most seized illicit drug by the NFRL, followed by methamphetamine, cocaine and NPS.

It is interesting to see that, in comparison to all other data sources, cannabis is rarely seized in parcel post which is probably due to the abundant domestic cultivation (with the exception of resin, oil and seeds), making cannabis trafficking into Australia unnecessary and/or unprofitable [10,24]. The sale of cannabis is thus likely to be domestic (i.e. from Australian vendor to Australian customers). Furthermore, according to a recent study investigating the prices of illicit drugs in the Australian cryptomarket drug trade, cannabis is the only category that does not vary in price between countries while the price of other illicit drugs is significantly lower when purchased from a country other than Australia [31]. Given the tight control at the Australian border and the limited profit cannabis incurs, shipping cannabis to Australia might be too risky and not financially viable [32].

With the exception of cannabis, the seizures made through the NFRL tend to reflect the proportions observed using the EDRS data and cryptomarkets data. The predominance of recreational consumers or *psychonauts* on online markets [28–30,33], population typically targeted by the EDRS, could explain this trend. It is worth noting that an entire section of the 2015 EDRS report was dedicated to the use of darknet marketplaces, further emphasising the popularity of these marketplaces among recreational users [9]. Eleven percent of the sample reported having purchased an illicit drug online in the 12 months preceding the survey [9]. Of those consumers using darknet marketplaces, 28% of them reported

	Sender Country										Total
	Belgium	Canada	China	Germany	Hong Kong, SAR China*	India	Netherlands	Spain	United Kingdom	United States of America	
Amphetamine	35			118			104	58	3		318
Cannabis		21		4		4	18	16		11	74
Cocaine	43	130		100		4	93	22	20	121	533
Ecstasy & MDMA	168	222		583			498	10	163	4	1,648
GHB and GBL	3	1	10		3		7			6	30
Heroin	1	11		1		23	12				48
Ketamine		23		7	4	2	5	1	9		51
LSD and derivatives	14	40		3			21	3	12	9	102
Methamphetamine	10	137	144	10	106	44	2			72	525
Mushrooms		3						1			4
NPS	1	48	118	2	4	2	102	136	64	18	495
Other	1	1	1	6		17	28	30	2	32	118
Other ATS		22		6			1		1	2	32
Total	276	659	273	840	117	96	891	277	274	275	3,978

Fig. 4. Number of illicit drug seizures per type of illicit drugs and per sender country (only the ten most prominent countries were considered). *Hong Kong Special Administrative Region of the People's Republic of China.

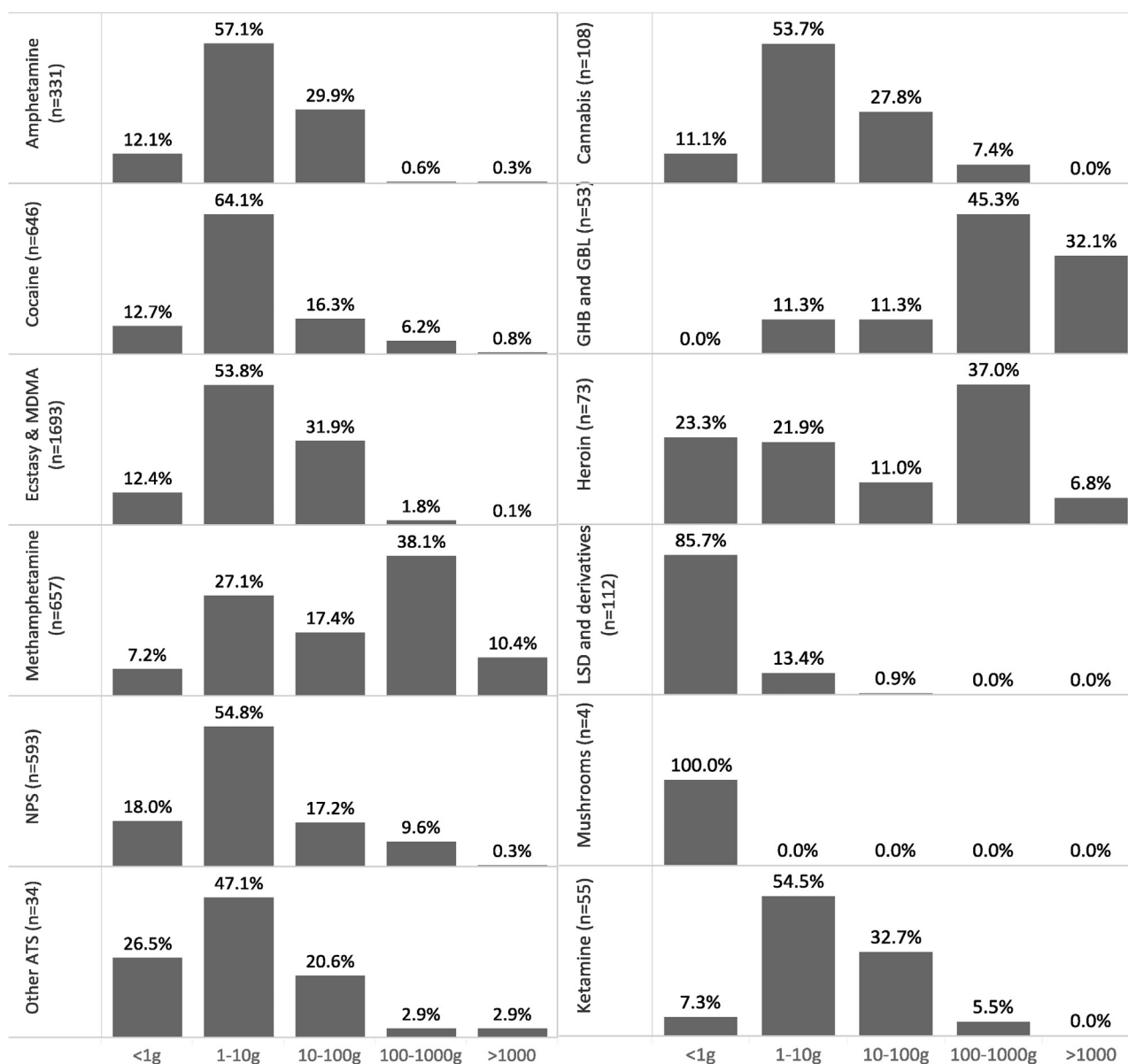


Fig. 5. Distribution of NFRL seizure weight according to the type of illicit drug. The seizure weight represents the total amount seized, not the active component.

having purchased illicit drugs from Australian retailers, 42% from international vendors and 31% from both Australian and international vendors. The main substances reported being purchased were ecstasy & MDMA, NPS, LSD and cannabis.

3.4.2. Shipping countries and their specificities

Fig. 3 shows the directional flows (origin and Australia as the destination country) of illicit drugs for which the origin country accounts for at least 1% of the total number of NFRL seizures. The countries that account for most of the importation into Australia are the Netherlands, Germany and Canada. Although the flow of illicit drugs on *Evolution* and *Silk Road 2* was mainly domestic, the ten countries that account for most of the parcel post items seized by the NFRL are similar to the countries that account for the majority of the trafficking on these two cryptomarkets [2,18].

More specifically, Fig. 4 represents the number of seizures made by the NFRL per type of illicit drugs and per sender country. Only the ten most prominent countries are represented. These countries account for 89% of the total number of illicit drug seizures made by the NFRL. The Netherlands and Germany account for the majority

of Ecstasy & MDMA and amphetamine importations. Canada, the United States, Germany and the Netherlands account for the majority of cocaine importation which is in line with the trafficking routes reported by the 2014 and 2015 World drug report [34,35]. China and Hong Kong Special Administrative Region of the People's Republic of China (Hong Kong, SAR China) seems to specialise in the exportation of specific illicit drugs, in particular methamphetamine (China ranks first as a sender country for methamphetamine in the NFRL seizures), NPS and to a smaller extent gamma-hydroxybutyric acid (GHB) and gamma-butyrolactone (GBL). Asia, in particular East and South-East Asia, is known to be the most established ATS market, both in terms of use and manufacture [10,36]. In 2013, 390 methamphetamine laboratories were dismantled in China, the majority of which were found to be manufacturing crystalline methamphetamine [36]. The number of NPS seizures coming from Spain and the Netherlands should also be highlighted. According to [37–39], China and India are often perceived as major manufacturers of NPS while Europe is perceived as a transit region. However, several European countries (e.g. Czech Republic, Hungary, the Netherlands, Portugal, Spain,

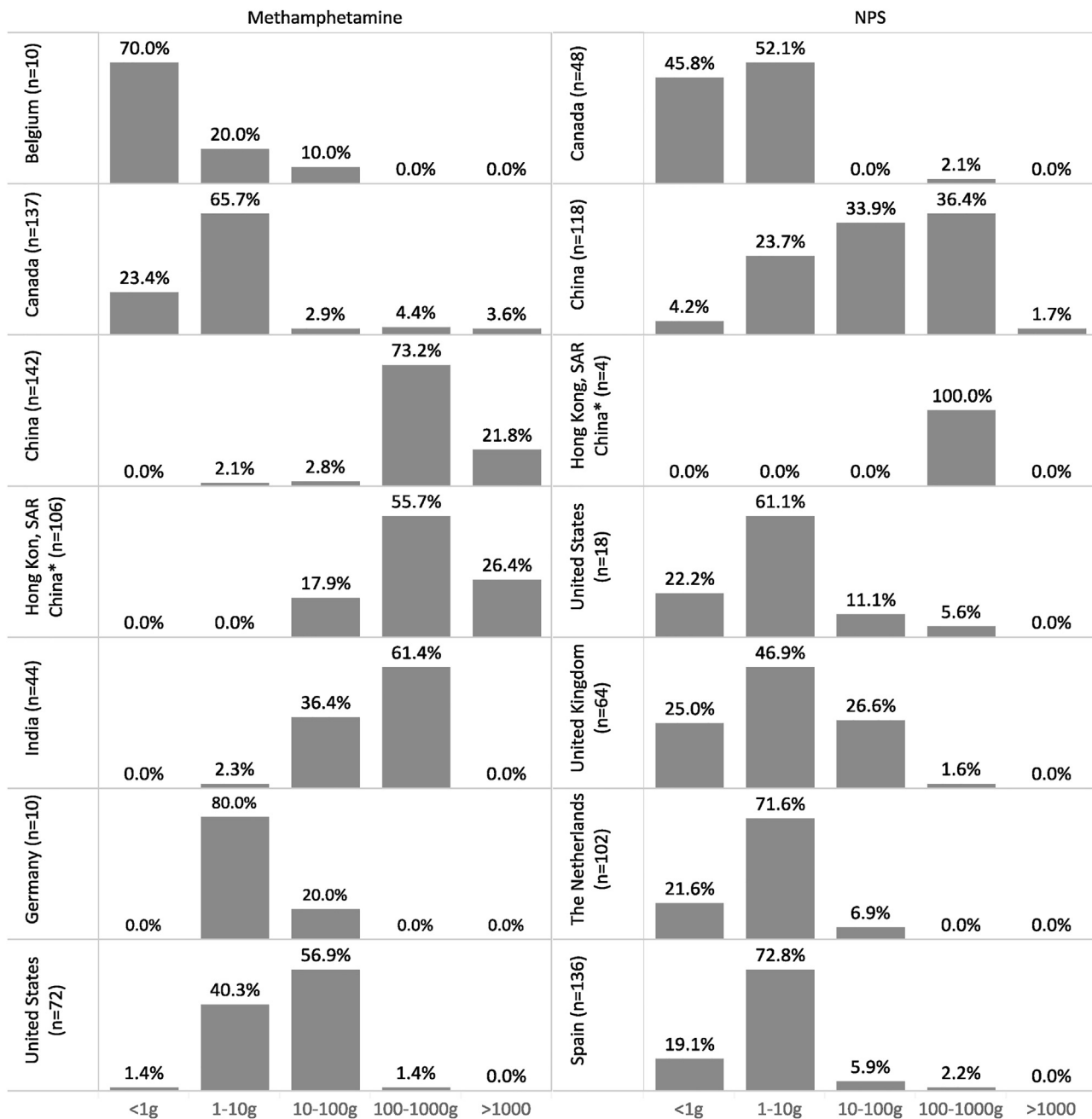


Fig. 6. Distribution of NFRL methamphetamine and NPS seizure weight according to the sender country. *Hong Kong Special Administrative Region of the People's Republic of China.

Ukraine and the United Kingdom) have also been identified as potential sources of NPS and could explain the relatively large number of NPS coming from Spain and the Netherlands. Interestingly, similar trends in terms of country specificities were observed in a geographical analysis of trafficking on the *Evolution* cryptomarket [18].

Fig. 5 shows the distribution of NFRL seizure weights according to the type of illicit drug. Interestingly, they are three illicit drugs that stand out, in particular methamphetamine and to a lesser extent heroin and GHB/GBL due to the lower number of seizures in comparison to methamphetamine. The majority of seizures are less than 10 g for all illicit drugs except for these three illicit drugs. This is particularly interesting for methamphetamine given the important number of seizures of this drug (n = 657), 48% of which are above 100 g (weight that can be associated with wholesale). It

is, however, important to keep in mind that the quantities of different drugs are not directly comparable since the ratio of weight to psychoactive effects varies from one drug to another [40]. For example, one gram of LSD is a large amount considering the typical dose reported being consumed is 1 tab [0.25–6 tabs] which usually contains approximately 100 µg whereas one gram of methamphetamine falls within the usual dose reported being consumed [9].

The trend observed in Fig. 5 is even more interesting when looking at the combined analysis of masses of methamphetamine and NPS seizures according to the sender country. Fig. 6 reveals geographical differences between the shipping countries. The seizures coming from the ten most prominent shipping countries are mainly of small quantities (<10 g) while seizures from China and Hong Kong, SAR China (and India for methamphetamine) are

characterised by larger quantities. This was also observed through the analysis of cryptomarkets in Ref. [18]. Underpinning this trend is the ability to order bulk quantities, in particular NPS, from China and India [1]. As mentioned previously, according to the Australian Illicit Drug Data Report 2013–2014 [10] and the 2014 World Drug Report [35], East and South-East Asia were the largest ATS market, in terms of use and manufacture. China was characterised by large-scale domestic production, evidenced by the detection of large clandestine laboratories during that period [41]. The easy access to large amount of methamphetamine could explain why the mass of seizures of this drug from China and Hong Kong, SAR China are relatively high.

4. General discussion and conclusion

Forensic intelligence takes advantage of the variety of information that results from traces. Considered as the remnant of a presence, activity and/or event, traces are one of the most robust and exploitable effect of crime phenomena [42,43]. The scientific and systematic processing of traces as well as their proper fusion with alternative or complementary information in a collaborative approach offers a unique opportunity to understand criminal activities, in particular when they are repetitive, organised and prolific. In 2010, the UNODC argued that law enforcement's focus on groups instead of markets was limiting its capacity to proactively deal with transnational crime [44]. It is argued that in order to tackle organised crime problems, the approach must include holistic responses that utilise networked law enforcement partners and stakeholders from outside of the law enforcement community [39,45].

The present study confirms that the combination of different information offers a broader perspective of the virtual and physical illicit drug market in Australia and thus provides stronger arguments for policy makers [15,16]. It highlights a link between the virtual and physical markets in terms of drug consumed, seized and trafficked. It is, however, recognised that cryptomarkets might target a specific population, in particular recreational users.

This study also showed that it might be worth targeting and screening domestic mail items as they might give further information on the trafficking routes within Australia. The packaging methods (or stealth techniques) used by vendors in combination with the information related to the shipping country on cryptomarkets could be further investigated. They could be used to monitor the evolution of concealment and inform border detection to target specific types of packaging. Rhumorbarbe et al. [46] purchased illicit drugs through cryptomarkets and their results showed that information displayed on *Evolution* (i.e. shipping country and concealment method) was consistent with the postal shipping received. As a consequence, it can be inferred that vendors reveal their actual *modus operandi* on cryptomarkets.

In conclusion, the authors believe that the triangulation of different data sources diminishes the uncertainty related to each data type and provides a more accurate overview of the consumption and distribution of illicit drugs in Australia. An interdisciplinary approach should be sought where criminologists, forensic scientists, toxicologists, sociologists and policy makers (to name a few) would interact and work together as the combination of their complementary knowledge about illicit drugs is paramount to proactively fight against illicit drug trafficking. This problem-oriented approach has proven to be very successful to describe and monitor the heroin market in Switzerland [47]. Further research is now required to focus on other drug types and in other countries to obtain a better understanding of the trafficking routes, sources of supply and various domestic markets. It is argued that not only is this approach a step towards the holistic response that has been called for in the area of transnational crime

but, at a general level, it can also make a significant contribution to a wide range of societal problems related to organised crime and deviant behaviour [48].

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