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Responsible vendors, intelligent consumers: Silk Road, the online revolution in drug trading

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ABSTRACT

Background: Silk Road is located on the Deep Web and provides an anonymous transacting infrastructure for the retail of drugs and pharmaceuticals. Members are attracted to the site due to protection of identity by screen pseudonyms, variety and quality of product listings, selection of vendors based on reviews, reduced personal risks, stealth of product delivery, development of personal connections with vendors in stealth modes and forum activity. The study aimed to explore vendor accounts of Silk Road as retail infrastructure.

Methods: A single and holistic case study with embedded units approach (Yin, 2003) was chosen to explore the accounts of vendor subunits situated within the Silk Road marketplace. Vendors ($n = 10$) completed an online interview via the direct message facility and via Tor mail.

Results: Vendors described themselves as 'intelligent and responsible' consumers of drugs. Decisions to commence vending operations on the site centred on simplicity in setting up vendor accounts, and opportunity to operate within a low risk, high traffic, high mark-up, secure and anonymous Deep Web infrastructure. The embedded online culture of harm reduction ethos appealed to them in terms of the responsible vending and use of personally tested high quality products. The professional approach to running their Silk Road businesses and dedication to providing a quality service was characterised by professional advertising of quality products, professional communication and visibility on forum pages, speedy dispatch of slightly overweight products, competitive pricing, good stealth techniques and efforts to avoid customer disputes. Vendors appeared content with a fairly constant buyer demand and described a relatively competitive market between small and big time market players. Concerns were evident with regard to Bitcoin instability.

Conclusion: The greatest threat to Silk Road and other sites operating on the Deep Web is not law enforcement or market dynamics, it is technology itself.

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Introduction

Cyber drug markets and online drug user communities are increasingly innovative in providing avenues for drug retail (Davey, Schifano, Corazza, & Deluca, 2012; Forsyth, 2012). The development of usable interfaces, electronic currencies and anonymous networks has facilitated ease of access of drug markets located on the Deep Web (Christin, 2013; Tor Project, 2011). The Deep Web is accessed via secure and confidential communication lines by encryption of computer IP addresses using Tor anonymising software or web proxy to the Tor network (http://tor2web.org) (Tor Project, 2011). For users transacting on Deep Web sites, Electrum is an anonymous Tor server used to access a virtual wallet containing the digital currency called Bitcoin (BTC). This ensures payment anonymity via online verifiable transactions occurring without a central third party (Bitcoin, 2011; Davis, 2011). At the time of writing, BTC can be bought at many online exchanges such as the Tokyo Mt. Gox and Bitstamp and is indexed to the USD (27/08/2013 valued at USD100). See Fig. 1 for an example of BTC.

Silk Road is the most famous novel drug trading site and is in operation since February 2011. It is located on the Deep Web. Whilst Silk Road is not a shop (Christin, 2013), it provides an online and anonymous transacting infrastructure similar to eBay by its visibility of vendor, buyer and product ratings to assist in member transaction decision-making, its professional dispute resolution mechanism, and Escrow system that releases payment to vendors on customer receipt of orders (Barratt, 2012). It has wisely maximised on its trust mechanisms by demonstrating it is not a typical counterfeit drug website scam. 220 distinct categories of drug and related products are listed for sale which include cannabis, ecstasy,

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Fig. 1. Bitcoin.

psychedelics, opioids, stimulants, benzodiazepines and dissociatives (Barratt, 2012; Christin, 2013). See Fig. 2 for an example of the Silk Road front page listings.

Consumer purchasing motives and decisions to access Silk Road appear grounded in so called 'responsible' drug consumerism, with users presenting themselves as drug connoisseurs (Van Hout & Bingham, 2013a,b). Other motivating factors include the protection of identity by screen pseudonyms, selection of vendors based on review feedbacks, trust building within anonymous transacting, variety and quality of product listings, distance from street sourcing, stealth of product delivery and forum activity within the active Silk Road community (Van Hout & Bingham, 2013a,b).

Of interest for this study is that previous qualitative work with Silk Road members in 2012 and 2013 (Van Hout & Bingham, 2013a,b) indicated members' intentions to commence vending on the site. Vendor authenticity and member opportunity to commence vending on the site are controlled through the payment of a refundable bond (at the present time USD500), and by the auctioning of new vendor accounts to the highest bidders. Vendors and buyers are mandated to use the Escrow system which facilitates transacting via tumbler services of dummy and single use intermediaries, and resolution of (any) dispute between vendors and buyers (Christin, 2013). Commission fees range between 3 and 8.5% of the sales price. Transactions can also take place out of Escrow via private messaging hosted by Tor. The dynamic site turnover of vendors is visible, with Christin (2013) reporting that a majority of vendors disappear within three months of market entry, with most items available for less than three weeks. Stealth and custom listings exist whereby vendors may exit the visible online listings, and custom is directed at certain buyers by providing the URL or via private messaging. Vendors active for over one month and with more than 35 successful transactions are allowed to request buyers to finalize early (release of payment before receipt of the product). This presents some concern for buyers, with potential for being ripped off (dubbed 'whitewashing') where vendors build an excellent reputation and relationship with its customer base and then exit, leaving a large number of paid but un-dispatched orders (Feldman, Papadimitriou, Chuang, & Stoica, 2006) and offering little recourse for dissatisfied customers (Christin, 2013). See Fig. 3 for an example of the Silk Road vendor roundtable page.

Comprehensive measurement analysis and site monitoring for a period of eight months during late 2011 and 2012 estimated total vendor revenue from public listings, as slightly over USD1.2 million per month, with approximately USD92,000 per month in commissions for the Silk Road operators (Christin, 2013). At the time of writing, Christin has since commented that Silk Road's traffic and reputation increased drastically over the past 12 months, with expectations that it had doubled its transactions to somewhere between USD30 and 45 million. According to Van Buskirk, Roxburgh, Bruno, and Burns (2013), increased traffic on Silk Road is largely due to international vendor activity. A June 2013 crawl of the site by StExo (a Silk Road member) revealed 1239 active vendors selling at any given moment. This represents double the number Christin reported on in August 2012. At the time of writing this paper in August 2013, we were able to view 13,426 listings originating from EU countries, the US, Australia, New Zealand, Canada, Russia, Thailand, Indonesia, Hong Kong, Singapore, Ghana, Japan, Vietnam, South Africa and the Philippines, along with 17,066 undeclared listings. Christin (2013) noted a clear bias toward vending activity from English speaking countries. It is important to note that countries may have several active vendors who may list or advertise more than once, and who dispatch to a variety of destinations.

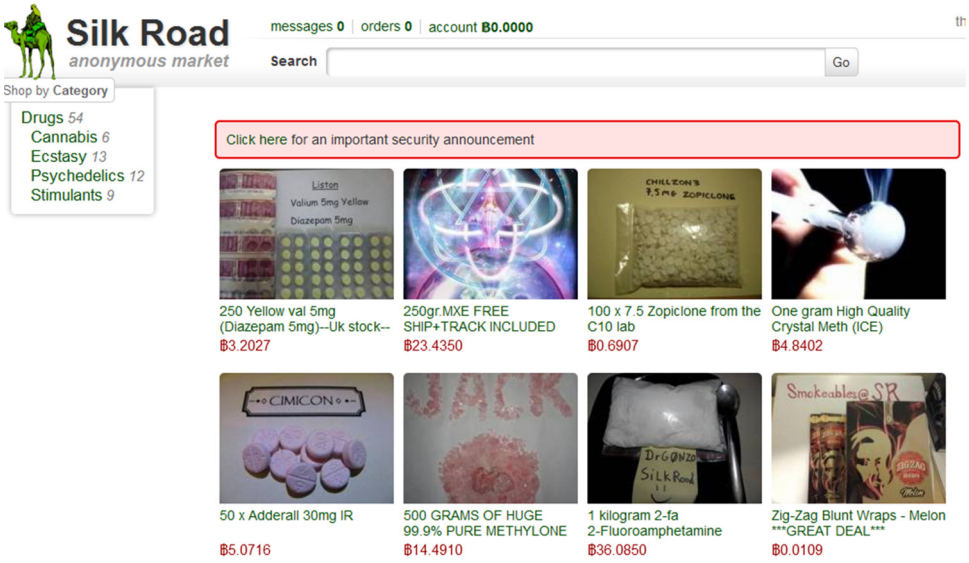

Fig. 2. The 'Silk Road' front page.

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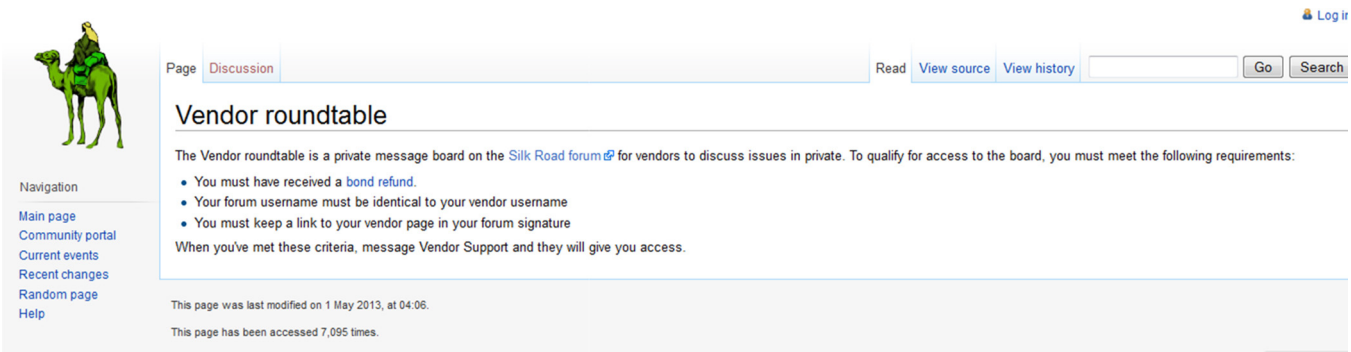

Fig. 3. The 'Silk Road' vendor roundtable page.

We present here the first successful attempt to engage with the vendor population on the site, and explore vendor accounts of their experiences of the Silk Road retail infrastructure for sale of drugs.

Methods

Ethical approval for the project was granted at Waterford Institute of Technology, Ireland. The study was undertaken as part of a longitudinal Silk Road site monitoring exercise which involved three phases; a holistic single case study with a Silk Road member (Van Hout & Bingham, 2013a), an integrated study of systematic site monitoring of forum activity and online interviewing of a cohort of Silk Road customers (Van Hout & Bingham, 2013b), and an interview study of vendor experiences of retailing on the site. The project adhered to best practice protocols for online research (Barratt & Lenton, 2010), for further detail see Van Hout and Bingham (2013b).

Author two was familiar with the use of Tor and private messaging on Silk Road, and acted as 'Privileged Access Interviewer' (Santis et al., 2004; Taylor & Kearney, 2005). He participated on site forums for 12 months prior to data collection in order to establish rapport and garner trust with vendors. Permission to undertake a study of vendor accounts of their experiences of the site was sought from the site administrator. Threads requesting participation in the research were posted on forums, along with threads presenting information on research objectives, ethics and informed text based consent. Negative and at times suspicious comments, along with interested queries were evident during this timeframe. A number of Silk Road members requested copies of earlier authored Silk Road publications (Van Hout & Bingham, 2013a,b) in order to validate the researchers' motives and intended approaches prior to participation.

Vendors willing to complete the online interview ($n = 10$) via the direct message facility through the Silk Road Forum, and via Tor mail were provided with a series of open ended questions, and advised to complete at their convenience. Visibility of vendor accounts on the Silk Road ensured that participating vendors were involved in the sale of drugs and pharmaceuticals. All communication was encrypted using PGP encryption software. This approach was chosen in order to facilitate vendors feed-back and to ensure secure communication at their convenience (Van Hout & Bingham, 2013b). Participants were not identifiable by either their personal name or Silk Road screen pseudonym, and were advised not to mention any potential identifiers. Data collection lasted six months.

The research adopted a single and holistic case study with embedded sub units approach (Yin, 2003). This was chosen in order to explore vendor accounts of their experiences as sub units situated within the larger Silk Road marketplace. Propositions based on extant literature, earlier work (Van Hout & Bingham, 2013a,b) and researcher experiences of navigating the site itself were used to guide and focus the data collection and subsequent discussion of narratives (Stake, 1995). These multiple data sources were targeted by propositions, and converged into the final data analysis in order to enhance rigor and data credibility ('truth value') (Knafl & Breitmayer, 1989; Yin, 2003). Propositions included vendor demographics, prior experience of selling drugs, introductions to the site, year of commencement of vending, reasons for vending, type of drugs sold, the Silk Road customer base, Silk Road retail processes, market development, vendor competition, supply channels, quality assurance and harm reduction, interaction on forums BTC, and law enforcement interference. We analysed data within, between and across subunits of each vendor, so as to illuminate these unique vending experiences within Silk Road setting as bounded context (Miles & Huberman, 1994). Pattern matching, linking back to propositions and building explanations was assisted by the software program QSR NVivo 8.0 (Qualitative Solutions and Research, 2008) which grouped the data into macro groupings, subsequent themes and appropriate categories (Elliott, 2006; Riessman, 2008).

Results

10 participants vending on Silk Road agreed to partake in the study. Nine were male. Ages ranged as follows: 25–29 years ($n = 1$), 30–34 years ($n = 4$), 35–39 years ($n = 2$), 40–44 years ($n = 1$), 45–50 years ($n = 1$), and over 50 years ($n = 1$). Four participants reported being in fulltime employment, one reported part time employment, one was in tertiary education and four participants were unemployed. Two participants reported graduate level educational attainment. We present here the participant accounts of their vendor experiences on Silk Road.

The online community of interested parties

All participants described a personal interest in the '*intelligent and responsible*' use of drugs, particularly ethno-botanicals, psychedelics and psycho stimulants. All reported intense use of the internet to research drug information and related outcomes (i.e. sites such as '*Erowid*', '*Bluelight*' and '*Topix*') and for interaction in user chat-rooms. They all reported becoming aware of Silk Road and its location on the Deep Web in late 2011 via chat-room activity.

No participants had purchased narcotics, research chemicals or pharmaceuticals online prior to accessing Silk Road because of concerns around site credibility, scamming and counterfeit products. Silk Road by manner of its huge choice of high quality drug products listed, and anonymous but insular member population within its secure infrastructure offered them the ideal opportunity to consider entry as consumers. Some participants observed that once entrenched in the '*Silk Road world*', that the '*the site itself is addictive*'. Many commented on its 24 hour nature and supportive safety net of member communication via Tor messaging and in forums.

The site's harm reduction ethos appeared centred on informed consumerism and responsible vending by availability of high quality products with low risk for contamination, vendor tested products, trip reporting, and feedback on the vending infrastructure.

> I think it is top of the list on harm reduction - Silk Road is all about the quality - you sell bunk gear, you will get burnt on the forum and your feedback so you lose sales. The forum is also great for what/what not to do with near enough any drug there is; best practices, dosage everything you need to know is all a quick search away on the forum. (Participant 4, Male, aged 30–34 years)

When questioned around personal purchasing histories on Silk Road, several participants had never purchased on the site, despite operating as vendors themselves. The majority described their purchase history as '*infrequent*'. Two participants with more regular purchase experience on Silk Road kept their vendor and buyer accounts separate, and described sourcing specific drugs (synthetic compounds and ethno-botanical products) not available to them in their locality, purchasing for personal use and in bulk for resale.

Secure or not?

Prior knowledge of computer technology was viewed as vital, with some concerns evident around '*trusting*' the infrastructure when transacting and some experiences of site unreliability in the past.

> The Deep Net is the Wild West though, so it's really to be expected. (Participant 7, Male aged 30–34 years)

Some wariness around the evolving of cyber security and the potential for coordinated attacks on the site itself were voiced. Participants generally viewed the Tor system as presently effective in providing security despite being slow in operation.

> The downside as a seller is the fact you have to trust the Tor network to keep you safe. If you are not a computer scientist, a lot is down to just faith. A seller has to learn a lot about the technology, if they are concerned with staying safe. It's a big subject to dive into and much deeper than what you may initially think. You also have to have faith in 'Silk Road' itself. Your whole selling history is stored on a server somewhere. That is not comforting. (Participant 9, Male aged 30–34 years)

Some participants described BTC as '*the digital equivalent of cash*' and a '*revolutionary way of transferring money*' outside of the banking system. Half of participants were concerned around BTC fluctuations in value with all participants describing their management of currency risk by factoring into product pricing, and cashing in at optimal values or at the end of each day.

Participant opinions on the future direction of Silk Road centred on the protection of the site and its expansion as secure drug selling infrastructure. Some comments [at the time of fieldwork] were made around the recent emergence of '*copycat*' competitors such as '*Atlantis*'.

The vending infrastructure

For the majority, the decision to set up a vendor account occurred within several weeks of interacting with other members in the site's forums. Motivations centred on the ability to use the infrastructure anonymously and as economically viable and secure business channel for the sale of narcotics, research chemicals and pharmaceuticals.

> The unique opportunity to make money. It fitted in with my lifestyle and it was kind of exciting. (Participant 9, Male aged 30–34 years)

One participant described his unemployment status and lack of financial opportunity in the '*real world*' as dictating his decision making to proceed to vend on the site.

> For me, it was very much the perfect storm. I found myself in a position where I had no job, no local connections and no real hope of change. I did however have many skills and experience with drugs, due to my recreational use and general interest. (Participant 5, Male, aged 30–34 years)

Advantages were described as multi-fold in terms of its security, low risk and simplicity of vending on the site, circumvention of national legislative controls, ability to sell products at a higher mark-up than in real life, high traffic volume of users and the large scale '*educated*' and wealthy customer base.

> Silk Road is far superior to traditional drug markets. It has a massive customer base that no other site will ever match. The opportunity to make money online is far greater than selling locally; even without moving lots of weight. (Participant 7, Male aged 30–34 years)

Six participants reported vending on Silk Road since 2012, with two commencing in 2011, and two in 2013. Two participants had never sold drugs either online or face to face before vending on Silk Road. The process of setting up a vendor account on the site was described as relatively simple, and consisting of the completion of an online form and clicking on the '*Become a Seller button*', payment of the bond and purchasing of BTC. Some participants described paying USD150 to purchase the vendor account, with others describing a recent increase to a USD500 returnable bond on completion of 30 transactions.

Sourcing of drugs for resale on Silk Road occurred via personal laboratories, personal contacts, outside in the case of ethno-botanicals and via Silk Road itself. Four participants reported consistently sourcing the same supplier. The remainder described switching suppliers in order to buy better quality products and in bulk, or when intercepted by law enforcement. Street vending for those who operated in both markets was observed to be restricted to local demands for '*MDMA, cocaine, GHB and opiates*'. Silk Road in contrast was observed to open the door for the sale of many other distinctive products; '*DMT*', '*MDA*', '*Mescaline*', '*Ketamine*', '*LSD*', '*Methamphetamine*', '*2CB*', '*Ps. Cubensis* spores', '25I-NBOMes', 'diazepam', '*prescription medications*', '*natural ethno-botanicals*', '*oxycodone*', '*morphine*', '*hydro-morphine*', '*methamphetamine*', '*methadone*', '*marijuana*', '*salvia*', '*2CB*', '*ketamine*', '*LSD*', '*kratom*', '*HBWR*', '*psychotria viridis*', '*seeds*' and '*drug paraphernalia*'. Several participants commented that vending via the '*Silk Road*' infrastructure by virtue of its complete anonymity and secure electronic transacting circumvented potential personal risks and harms associated with street vending by creation of social distance from their customer base.

> The street market is more risky for everyone. It doesn't have feedback or rating available for every buyer to read. You are more likely to be involved with people who might not be concerned in your welfare. (Participant 9, Male aged 30–34 years)

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Quality of drug products sold (with exception of known pharmaceuticals) was ensured by use of '*proper reagents, lab work (GMP) and analytics*', personal research and testing, '*freebie*' testing by long term customers, feedback from other vendors, and sourcing from reputable suppliers.

> I think there should be a difference acknowledged between drugs people get hooked on and need to use daily and drugs that people do for recreation or creativity or whatever. I source from a select few whose products I've tested and tried. Not a batch of anything goes out from me without it tested by myself. I do not sell anything I don't use myself. That is my moral standing and anything I sell on here is something I will happily use myself. (Participant 9, Male aged 30–34 years)

Participants declined to reveal their personal location, and the process of how dispatch of products occurs. '*Drop addresses*' were commonly used.

> I will not discuss exactly how, or how I get them through customs on international orders. However when I do ship international the packages look like any other package, the customs claim is good enough that the buyer can go down to the customs office if it is held and claim it. (Participant 1, Male, aged 35–39 years)

A minority of participants reported concern around product interception. All reported factoring this risk into pricing the product, and destroying postage information once the product was packaged. Many described using latex gloves and masks to ensure no traces of personal DNA get into or onto packages.

> I go to great lengths to make my operation as covert as possible. If they investigate me, they should not have enough information to make a case. (Participant 7, Male aged 30–34 years)

The market

Participants appeared professional and dedicated to providing a quality service in order to optimise on outputs and market flow. The maintenance of a customer base was described grounded in vendor reputation by regular updating of profile pages and forum activity, professional communications, competitive pricing, quality products, using good stealth techniques and speedy dispatch of slightly overweight items.

> Reputation on Silk Road is what keeps vendors in business. Your reputation is open to all. The seller who wants good business on Silk Road has to try and make every customer happy. Customer service has never been this good on the street market. (Participant 9, Male aged 30–34 years)

Participants observed that new customers were attracted to their products via professional photographs with grammatically correct description, pricing, quality of their products, reports of speedy dispatch, positive feedback relating to stealth listings, and overall excellent customer service. Many participants observed '*satisfaction*' on reaching a stable quota of customers. All participants commented on the time investment required to maintain a customer base which involves site activity, sourcing drugs, ensuring quality via personal or lab testing, packaging and BTC exchanging.

> Not fussed about attracting new customers, have enough to keep me going. keeping prices as low as possible, shipping promptly and using good stealth techniques gets you good reviews on the forum, so more customers come to you. (Participant 4, Male, aged 30–34 years)

Three participants described selecting to transact with buyers based on their feedback ratings, with the remainder happy to sell to all potential customers. All participants would sell to a buyer with less than five transactions on Silk Road, and voiced trust in the Escrow system and use of dispatch tracking notices. Some avoided potential customers with negative purchase history feedback (i.e. returns or item not received) or those with requests to order large bulk orders, and requested such customers to '*finalise early*'. Some negative experiences were described where vendors didn't get paid immediately, with a few concerns voiced around inability to prevent scams or being ripped off by customers. Disputes with customers were described as infrequent and centring on non-arrival of packages, and resolved by marking products as '*not arrived*' and refunding or resending the product. Few reported having to use the Silk Road dispute resolution mode, with all commenting favourably on this form of support intervention if needed.

Vending was described as fairly constant in terms of buyer demand, with the site observed to be relatively competitive but with more than enough customers to go around, particularly in the case of MDMA and LSD markets, and operating with '*a big sense of community and camaraderie.*' Several participants commented on the visibility of vendor turnover on the site.

> It would seem like there is a high amount of turnover in small time vendors. There are a solid 10–20% of serious vendors. They are, most likely, full time and take care in what they do. Basically, they have a significant investment made in their business. It's the difference between a hobbyist and a business. (Participant 7, Male aged 30–34 years)

Many participants traded intermittently on the site, by listing for a few weeks and then operating via '*stealth mode*' on reaching a quota of customers. Half of participants had not yet used this option, which was also used when low on stock, and when special size orders were requested.

> I treat any interaction with customers with a lot of care. When people get my packages, they are usually so impressed with the stealth, they come back. If someone makes a deal with me on a custom quantity or price, I'll make a stealth listing for them. I do that so someone else can't grab the deal before they do. Only the intended party has the link. (Participant 7, Male aged 30–34 years)

Discussion

We are grateful to the Silk Road administrator (dubbed 'Dread Pirate Roberts') for agreeing to facilitate the research and the participating vendors who have provided a unique and illustrative account of their experiences on the Silk Road retail infrastructure. We recognise that this unique case study with its embedded subunits cannot be deemed representational of all vendors operating on the site. The narratives of these vendors are constructed and represented with a purpose within the interview context, by allowing unique insight into the cyber-social world of Deep Web drug market determinants, consumer pathways and outcomes. Equally, the use of the Internet as source of public health research necessitates careful validation against established data sources, and consideration of potential biases (Dasgupta et al., 2013). To some extent, the work builds on situational, relational and structural elements identified in real life drug market hierarchies (Bourgois, 1995;

Fitzgerald, 2009; Maher, 2000; May, Duffy, Few, & Hough, 2005; Singer, 2001).

Similar to our earlier work on Silk Road consumers (Van Hout & Bingham, 2013b), these vendors described themselves as 'intelligent and responsible' informed users of drugs with particular personal interests in ethno-botanicals, psychedelics and psycho stimulants. They reported extensive online trawling of drug related sites, chat-rooms and Silk Road forums. Of interest is that by virtue of its 24 hour and insular nature, the Silk Road entrenched community was viewed as addictive. The site's libertarian ethos and embedded online culture (Van Hout & Bingham, 2013a,b) appealed to them in terms of its revolutionary ethos and mechanism for the responsible vending of personally tested high quality products, informed consumerism and controlled safe retail infrastructure. The professional approach to running their Silk Road businesses and dedication to providing a quality service was characterised by their efforts to avoid customer disputes, ensuring professional advertising of quality products, professional type communication and visibility on forum pages, speedy dispatch of slightly overweight products, competitive pricing and operation of good stealth techniques. In terms of pricing on Silk Road, Van Buskirk et al. (2013) reported that average international and domestic (Australian) prices of methamphetamine, cocaine and ecstasy sold on Silk Road remained stable in their site monitoring time frame, with average international prices substantially lower. Indeed, Dasgupta et al. (2013) in their research on crowdsourcing of combined street and online black market pricing of diverted pharmaceuticals, observed that connecting online drug prices to behaviours and health outcomes could form the basis of future research.

Given Silk Road's potential built in quality mechanisms for safer drug use, previous commentaries have suggested the need for a shift in drug policy focus toward reducing consumer demand for web retailed drugs and optimising on the site's capacity for encouraging safer forms of drug taking amongst a very hard to reach and informed drug using population (Van Hout & Bingham, 2013a,b). The participant accounts reflect this, and are supported by their active participation in the Silk Road forums by providing harm reduction advice, information and support to other Silk Road members, and therefore presenting a unique technology-driven, market-led form of harm reduction. This is supported by Barratt, Lenton, and Allen (2013) who in their research on websites involved in the retailing of drugs, reported that certain websites contributed positively to harm reduction, by assisting users in making informed decisions, and in accessing relevant and more comprehensive information, than available elsewhere. They commented on the blocking of open websites as potentially driving drug user discussions underground, and with Deep Web retail infrastructures such as Silk Road unaffected by such Internet filtering.

Drug vendors are often portrayed as 'outsiders' preying on local communities, with markets supply driven and centring on 'pushers' creating and exploiting markets (May et al., 2005). In reality, this is not the case, and less so for an online retail infrastructure such as Silk Road. Caulkins and Reuter (2009) have highlighted the need for drug policy makers to recognise that 'not all dealers are equally destructive' (parallels can be drawn here with the responsible beverage service in the alcohol industry) and that the adaptable nature of drug markets, online or otherwise, and displacement 'pushdown/pop up' creates opportunity for reshaping such markets to make the most harmful sub market of drug vending unattractive for vendors. Along with the site's drive toward recreational drug marketing and promotion, the requirement for certain technological expertise restricts access to more vulnerable problematic drug customers (Van Hout & Bingham, 2013b).

Silk Road by manner of its large scale and credible operation, its huge choice of high quality products listed, and its anonymous but insular member population within the secure infrastructure provided these vendors with the ideal opportunity to enter this drug market initially as site members. Of interest is their prior lack of online sourcing experience similar to the earlier study on Silk Road member experiences (Van Hout & Bingham, 2013b) concerns for credible online drug purchasing, and for a minority lack of (any) drug dealing experience. In contrast to May et al. (2005), Silk Road buyers and vendors do not appear to represent two distinct species. Decisions to commence vending operations on the site centred on the simplicity involved in setting up a vendor account (similar to decision-making in the mainstream Ebay site), and ability to operate within a low risk, secure Deep Web infrastructure. The lure of vending within an economically viable and secure business channel with high volume of site traffic, educated and wealthy customer base, availability of distinctive ethno-botanicals and synthetic compounds, pricing profits and capacity to circumvent national legislative controls was attractive. Vendors reported ensuring quality by researching, sourcing from reputable suppliers, lab testing, personal and '*freebie*' testing of their products. Similar trends have been observed in illicit drug markets where drug users obtain drugs for free or in exchange for goods and services, quantity discounting occurs, and drug sales occur within closed social networks (Manksi, Pepper, & Petrie, 2001). Closed social networks in the Silk Road sense consist of stealth and custom networks.

Given the global dimension of the Silk Road consumer base, vendors appeared content with a fairly constant buyer demand, and described a relatively competitive market of small and big-time market players. Efforts to estimate the size of the Silk Road operation are clouded by its dynamic nature of visible product and vendor listings, turnover and stealth mechanisms. Site monitoring in 2012 reported a majority of vendors disappearing within three months of market entry, with most products available for less than three weeks (Christin, 2013). A certain level of risk negotiation was evident in terms of trusting the infrastructure to operate in a secure manner. Participant concerns were evident with regard to recent BTC instability despite its hedging system to protect against fluctuations whilst products are in transit. Hidden networks in closed stealth markets supported by the Deep Web with its vast infrastructure of multiple nodes and players reduce individual vendor risks and present a host of law enforcement difficulties. Vendor risks were dealt with in a rational manner (Bright & Ritter, 2010; Caulkins & MacCoun, 2003; Reuter & Kleiman, 1986) by factoring into pricing, use of drop addresses and removal of DNA identification. It was regrettable but understandable that participants declined to reveal their personal location, and how the dispatch of products occurs. Silk Road recommends the provision of delivery addresses distinct from the buyer's residence, with shipments of products commonly disguised by use of vacuum sealed professional looking packages (Christin, 2013; Van Hout & Bingham, 2013a,b).

Drug markets are incredibly resilient and adaptable to changes in the environment, market driven, law enforcement or otherwise (Bright & Ritter, 2010). Challenges do exist in disembedding drug markets (May et al., 2005) and are reliant on the complexities of relationships between vendors, markets and communities, both online and in reality. Operating on the Deep Web appeared to present vendors and consumers with a novel way to circumvent drug market violence and create distance between vendor and buyer (Christin, 2013; Van Hout & Bingham, 2013a,b). The drug trade represents a key cause of violence, particularly in urban settings, and especially as a means for individuals and groups to secure and maintain market share (Bright & Ritter, 2010; Brownstein, Crimmins, & Spunt, 2000; Martin et al., 2009; Reuter & Kleiman, 1986; Werb et al., 2011). However, where illegal money goes, virtual violence in the cyber sense follows, with parallels drawn with the closed street based market as described by May et al. (2005). Our observations suggest that the greatest threat to Silk Road and

other sites operating on the Deep Web is not law enforcement or market dynamics; it is cyber-technology itself.

In May 2013 and coinciding with the launch of the rival site Atlantis, Silk Road experienced a sophisticated cyber-attack which overwhelmed its servers, taking advantage of previously unknown vulnerability in the Tor system. Freedom Hosting the largest hosting service for sites operating on the Tor network was shut down in late August 2013, with subsequent disappearance of many sites relying on the Tor anonymisation service. This recent trend toward cyber interference is not confined to the Tor system, with BTC increasingly under global regulatory focus, despite efforts to regulate Tor websites and BTC posing a unique challenge to drug prohibition tactics (Barratt et al., 2013). In May 2013, Tokyo's Mt. Gox the largest BTC currency exchange announced the requirement for identification for any individual intending to trade for real world currencies. On 23 June 2013, BTC were listed as a seized asset in United States Department of Justice forfeiture via DEA filing (Jeffries, 2013). Law enforcement efforts are also increasingly tightening the net, with dealers using Silk Road in the US and Australia arrested in mid-2013.

On October 2, 2013, the Federal Bureau of Investigations arrested the 'Dread Pirate Roberts', founder and administrator of Silk Road on charges of alleged murder for hire and narcotics trafficking violation, Silk Road was shut down and customer traffic diverted to Atlantis, the up and coming competitor of Silk Road. Subsequent reports shortly thereafter report on the disappearance of this site from the Deep web amid reports of whitewashing of customers cash (Jeffries, 2013). We recommend continued monitoring of sites involved in the sale of narcotics, pharmaceuticals and research chemicals, including those on the Deep Web.

Conflict of interest

The authors declare no conflict of interest.

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