



The 21st Century DarkNet Market: Lessons from the Fall of Silk Road

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Abstract

Silk Road was an online marketplace through which consumers bought and sold drugs and other contraband. It ran successfully for almost two years, generating millions of dollars in revenue for the users and for the administrators. The FBI shut it down in October 2013, resulting in a seizure of \$3.6 million of funds in escrow. The shutdown also led to the arrest of Ross Ulbricht, the alleged founder and chief operator of the site, known by users as the Dread Pirate Roberts. This exploratory research examines the events surrounding the site's closure via content analysis of three Dark Net market forums. The analysis draws conclusions about the behavior of the Dark Net market user base and the potential of these marketplaces in the future. This research also adds to the growing body of knowledge about the behavior of close-knit, clandestine groups on the Internet.

Keywords: Silk Road, Dark Net Markets, Internet Black Market.

Introduction

The rise and fall of Silk Road stands as one of the most unique stories in the history of the Internet. The Silk Road website was an international network of drug dealers and buyers that existed on the Dark Web, a portion of the internet that is unavailable by standard search engines. Through a sophisticated system that involved an anonymous, web-based currency, a military-grade private web browser, and a mysterious founder known as the Dread Pirate Roberts, the site managed to avoid worldwide law enforcement for almost two years. When it was finally seized by the FBI in October 2013, there were huge questions left in its wake. What was taking the FBI so long? Who is the Dread Pirate Roberts? And, perhaps most importantly, what happens to the dark net networks now?

The specific topic of Silk Road has been only minimally covered in academic literature. The current research includes only few academic studies: Van Hout and Bingham (2013, p. 385) conducted a single user case study of the site that shows how

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users buy products from the site's vendors and how they interact with each other through the site's discussion forum. Barratt (2013) conducted a study about Silk Road's potential for harm reduction among drug users. Christin (2013) did a more technical study about the volume of transactions on the site. The researchers describe Silk Road forum as a place where users could go to get information, discuss important issues about the site and its mission, and generally have a sense of community with one another.

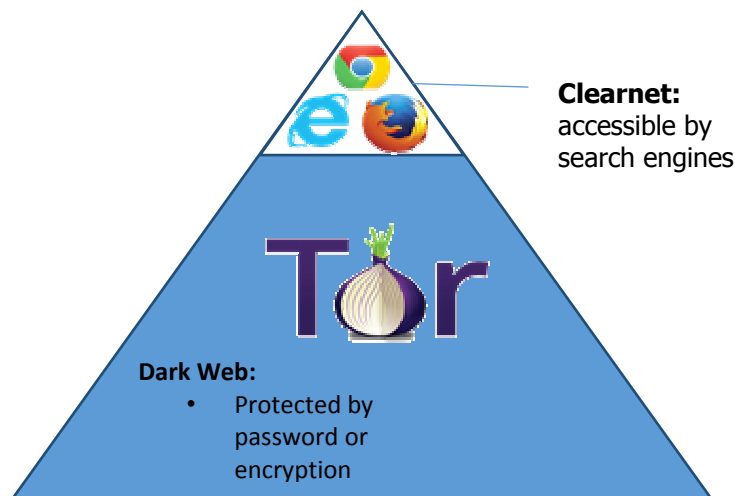
All of the literature currently available about Silk Road has been published before October 2013, and therefore does not take into account the closure of the site in its' assessment of the user base. Furthermore, while some research has been done on individual users and the site's transactions, very little has been researched about the community as a whole. This research explores the behavior of the Dark Net user base surrounding the closure of Silk Road in October of 2013 with the intent of helping determine the future of the Dark Net markets, and what form, if any, a new version of Silk Road could take. This research also adds to the growing body of knowledge about the behavior of close-knit, clandestine groups on the Internet.

Literature Review

Since the study of the Dark Web is a new topic in academia, the available research on this topic is still limited. In this section, we examine the literature about Dark Web, the online black market user-base, Internet law enforcement, and virtual communities.

a. Dark Web

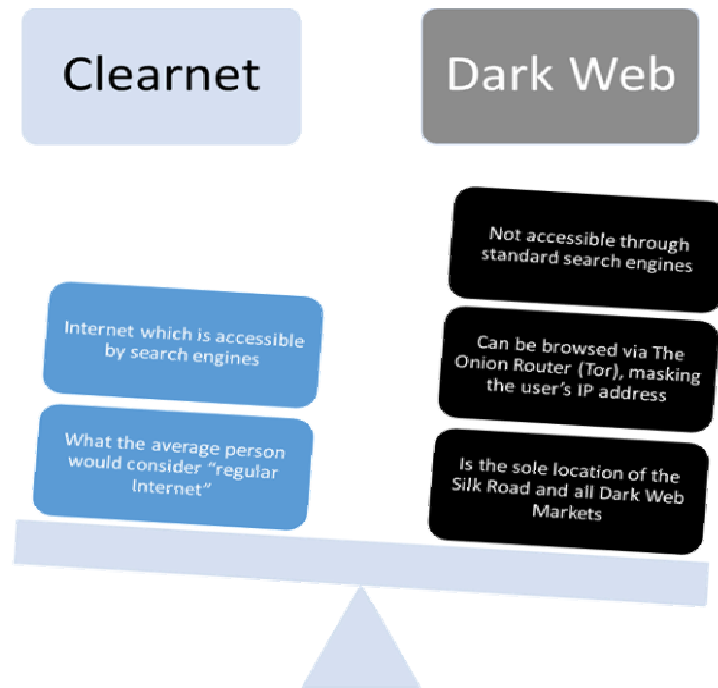
Figure 1



The Dark Web is the global network through which users accessed Silk Road. Dark Web consists of Internet content that is not accessible through standard search engines. Information on the Dark Web is typically not available to the general population, and is intentionally hidden from the regular Internet, known as Cleartnet (see Figures 1 and 2 for details). One of the primary modes of Dark Web access is The Onion Router (abbreviated as Tor) which “covers your online tracks by blending your internet traffic into data from many servers worldwide to make you functionally invisible” (Hodson, 2014, p. 2). The

Silk Road domain name, <http://silkroad6ownowfk.onion>, was only accessible through the Tor browser, and always consisted of a seemingly random set of characters followed by “.onion.”

Figure 2



The Dark Web began with ARPANET, the Internet’s progenitor that was developed by the Pentagon in 1969. As the inter-computer interaction began to grow, “a number of isolated, secretive networks started to appear alongside ARPANET” (McCormick, 2013, p. 22). These networks eventually became the medium of choice for the U.S. Naval Research Laboratory, which introduced a browser called The Onion Router. Tor, as it is called now, “conceals the location and IP addresses of users who download the software” (McCormick, 2013, p. 22) in order to protect overseas American operatives and dissidents. However, the software became available for public consumption in 2004, and Tor domains dedicated to drug dealing, child pornography, and terrorism began cropping up.

An important note about the history of Tor and the Dark Web is that the two terms are not interchangeable. It is possible for information to exist on the Internet and for it to be neither accessible by Tor nor by traditional browsers, but through some other browser or medium. One such alternative, called Hyperboria, was examined by Hodson (2014). Hyperboria “binds people together in a network that severs the link between them and their IP addresses” (Hodson, 2014, p. 4). Rather than blending traffic and IP addresses through a system of proxy servers, as Tor does, it removes the IP address from the connection altogether. However, in exchange for security, the process loses simplicity. With Tor, the potential user can download the browser from the Clearnet, as if they were

downloading any other browser. Hyperboria requires the user “to access [his] command prompt, install something called the cjdns protocol, and find someone willing to vouch for you and become the bridge that allows your computer to connect” (Hodson, 2014, p. 5). This prevents Hyperboria from being a serious contender with Tor for the time being, with a user base still in the hundreds. However, Hodson also asserts that “small groups of dedicated hackers are building their own wireless networks to run Hyperboria on” and that “[anonymous networks] are growing in the wake of Edward Snowden’s revelations about NSA surveillance” (Hodson, 2014, p. 6).

In summary, the Dark Web encompasses a vast amount of information on the Internet, the majority of which is inaccessible to the average user. Tor, the most popular Dark Web browser, which was initially created as a security measure by the U.S. Navy, is now the medium of choice for illegal sites ranging from drug dealing to assassination and terrorism.

b. Silk Road Users

According to the FBI’s criminal complaint filed in Ross Ulbright’s trial, the Silk Road market had almost 150,000 buyers and almost 4,000 vendors (USA v. Ross Ulbright, 2013). The user base was most heavily located in the United States, but included individuals from all across the world, if they chose to declare their location at all. Along with the site itself, with messaging features to allow the buyers and vendors to interact, Silk Road users also had access to a Tor-based forum with discussions about drug effects, Bitcoin currency, vendor ratings, and transaction capabilities. This made the site not only a haven for free exchange of contraband, but a store of information about a wide variety of topics and a global community with its own values, beliefs, and internal conflicts.

One of the more surprising aspects of Silk Road community is its level of coordination and structure involved in transactions. This concept was explored further by Van Hout and Bingham (2013), who conducted a case study of a Silk Road user’s experience. The user described that “relationships between vendors and consumers were...based on levels of trust and professionalism” (Van Hout & Bingham, 2013, p. 387), with each vendor having their own method of concealment and delivery of products that served as a demonstration of authenticity. This, along with the relative quality of the product, would be factored into a rating system that was reflected on the vendor’s profile.

From the consumer end, the users generally had an idea of what they were buying and what its value was. A study conducted by Dasgupta (2013) found that the buyers were able to “provide a valid estimate of the street price of diverted prescription opioids... [and] predict the relative pharmacologic potency of opioid molecules”, (p. 178) actually matching up accurately with Clearnet sources and the estimates given by law enforcement officials. This type of knowledge was readily available on the Silk Road’s forum, in order to prevent other users from being scammed or cheated.

The second surprising feature of the site was the emphasis by its creators, regular vendors, and user base as a whole, on building cohesion and camaraderie. Whether this was the intention of Silk Road’s founders from the beginning or a natural result of the site’s format and structure is unclear. In her study about the relationship between drugs and the Internet, Walsh (2011, p. 57) asserts that “the Internet provides a sense of community that can be difficult to find offline, particularly for those involved in relatively obscure psychedelic drug use and/or domiciled in remote locations” (p. 57). Although Silk Road’s forums contain more than information about the drugs themselves, any information about something sold on the site was readily available. The result is that “drug

forums transmogrify into street corners, threatening the continued existence of the current system of global prohibition” (Walsh, 2011, p. 60).

While such a result would be seen as a blow to attempts by governments and agencies to reduce drug abuse, Barratt et al. (2013, p. 201) find that the dissemination of drug-related information to be a net positive to both users and to the wider community. The research showed that “websites dealing with drugs...in fact contributed positively to harm reduction” (Barratt et al., 2013, p. 195). Silk Road forums did hold advice on what certain drugs did and what safe practices were when handling them. While the ideal situation in the eyes of law enforcement would be to cease drug use altogether, one of the forum’s most positive gains was its advice on prevention of abuse.

Generally, forum users are prone to extremism of opinion and tendency towards debate and disagreement. A high degree of social structure and cohesion was a conscious effort on the part of the forum. However, radical tendencies are common to all online communities, particularly those which are considered close-knit or exclusive. King (2001, p. 414) found that “the online world is a potent cultural environment subjectively built on fundamental sentiments much more extreme than those typically invoked in other environments.” He showed that, although opinions about the Internet as a whole were generally fairly positive, disagreements about other topics were typically deep-rooted and stark. However, these disagreements did not necessarily result in lower social cohesion of the community. As it was in the case of Silk Road, “shared cultural sentiments, even if they are extreme, encourage cultural stability because they make visible the behavioral expectations embedded in that culture” (King, 2001, p. 429).

More specifically, a topic that can cause adamant disagreement in general is politics. In the case of Silk Road, the politics of the site have not been researched, but the forum does bear some resemblance to controversial sites like WikiLeaks that deal in secrecy and illegality. Curran and Gibson (2013) find that the culture of the WikiLeaks user base exhibit “antisocial character, megalomania, and anarchism”, (p. 301) the latter of which is the focus of the study. The study suggests that the anarchical format of the site and its technology actually inform the political and social views of its user base. The study concludes that “the notion of transparency activism,” which is the use of modern technology to create more transparency in government, “is itself central to the revolutionary ideas and aims that form the core of WikiLeaks” (Curran & Gibson, 2013, p. 294). Whether, such a connection could be found in other sites remains to be seen.

Overall, it appears that the user base of Silk Road exhibits three predominant traits of coordination, social cohesion, and extremist tendency. The first two appear to be the result of the trust and camaraderie brought about by the site’s perceived exclusivity creating a perception of authenticity and organization between and among the site’s vendors and buyers. By contrast, the radical political and social views of the site seem to be common among close-knit online groups. These are possibly further reinforced by the Silk Road’s free market, anti-regulatory format.

c. Law Enforcement

The matter of law enforcement on the Internet has been a source of debate both in academia and in the courts. As a medium, the Internet has become a haven for both the innovator and the criminal, creating a line between the two that has become more

ambiguous over time. Being able to regulate such a vast and complicated network comes with a variety of problems, both logistical and ethical.

From a logistical standpoint, one of the most unique challenges law enforcement faces is finding and tracing potential criminals. This typically requires the use of search engines primed for specific phrases or images that are considered suspicious or illegal. However, in the case of the Dark Web, the law enforcement challenge becomes even greater, as most search engines can only generate results from the Clearnet. Zhen et al. (2013, p. 201) state that “to obtain content of Deep Web is challenging and has been acknowledged as a significant gap in the coverage of search engines.” Being unable to find or track information on Silk Road efficiently may have contributed to the inability of the FBI to shut down the site initially.

In addition, the structure of Tor is purposefully designed to allow complete anonymity to the user. Typically, Internet usage can be tracked through the use of an IP address. When a site is accessed, the computer’s IP address is connected to the page view, which can then be traced to the computer and therefore the owner. By contrast, Tor uses nodes (proxy computers) to connect users, which “have no incriminating information to turn over, nor can they effectively police the activity of users” (Abbott, 2010, p. 23). Also, any computer with Tor installed can act as a node, with the software existing on a multinational level. This in turn means that “a court order in one country might shutdown a handful of nodes, but the removal of a substantial portion of nodes would require multinational cooperation” (Abbott, 2010, p. 24). Therefore, Tor itself acts as a serious deterrent for law enforcement for all of the sites it hosts.

Christin (2013, p.220) suggested a number of ways in which law enforcement could engage Silk Road, proposing “four possible intervention strategies that could be considered: disrupting the network, disrupting the financial infrastructure, disrupting the delivery model, and laissez-faire”.

The first of those options would involve shutting down Tor, which, as stated previously, presents numerous difficulties. The financial infrastructure refers to Bitcoin, the currency with which Silk Road operated. This would involve an “attempt to manipulate the currency to create rapid fluctuations and impede transactions” (Christin, 2013, p. 221). While this is more feasible than stopping Tor, it would require significant financial investment and would likely be a temporary solution. Disrupting the delivery model, which is national and international mail, requires that “coordination between agencies is paramount” (Christin, 2013, p. 221). Finally, the laissez-faire option would mean allowing the markets to sabotage one another and focus on abuse-prevention. Currently, it is unknown whether any or all of these methods were used by the FBI.

The feasibility of Internet law enforcement also informs a secondary discussion, which is the issue of legal ethics. As a bastion of free speech and a tool for great good and innovation in the world, Internet freedom is a concept that has been fought for in courts since its inception. Andrew (2010), in his findings about a quarantine scheme for a computer virus that possibly threatened Internet freedom, found that although “one of the attractive features of the internet is its freedom...the music industry is being killed by the reduction in royalty income due to illegal distribution” (Andrew, 2010, p. 1097). Similarly, while Tor acts as a platform for drug trafficking, it also gives freedom of speech to individuals living in oppressive regimes by allowing them true anonymity.

The right of free speech in general is the argument for Tor and the Dark Web. The possibility of regulation of ideas on the Internet is explored by Gardella (2006) and Tyson

(2010). The former is a discussion of the potential chilling effect on the Internet of broad legislation in response to terrorism. In essence, Gardella argues that “the terrorist threat will likely plague society well into the future” (Gardella, 2010, p. 689), and that broad legislation in an attempt to curb it “may have minimal benefit in countering terrorism while having deleterious effects on fundamental rights” (Gardella, 2010, p. 690). A similar argument could be made for Silk Road: attempts to stop Internet drug trafficking by limiting Tor’s features have the potential to limit the positive aspects of Tor as a tool for the oppressed.

Tyson (2010) research has a similar thesis, albeit with a different approach. Tyson uses a single case analysis of an Internet privacy case in New Jersey as an example of how law enforcement could handle content regulation over the Internet without overstepping the bounds set by the Constitution. Tyson asserts that “subtler and more far-reaching means of invading privacy have become available to the government” (Tyson, 2010, p. 1). Much as in the case of Silk Road, the possibility of overreach exists there. However, the Supreme Court of New Jersey, in the case of *State v. Reid*, recognized that “Internet users maintain an expectation of privacy...without unduly frustrating law enforcement’s goal of catching criminals” (Tyson, 2010, p. 29). This seems to be a feasible middle ground, and one that could be used again when dealing with Tor, if only on a national level.

Law enforcement on the Internet faces further limitations when considering the effect of multinational jurisdiction. Essentially, the issue arises because “cybercrime increasingly tends not to occur in a single sovereign territory” (Brenner, 2007, p. 189). Although Silk Road was ostensibly run in the United States by Ross Ulbricht, its vendors and users were located worldwide. Indeed, many of the site’s administrators lived overseas and had access to the source code, which would explain how the site and its forums rebounded as quickly as they did after the initial site closure in October 2013.

d. Virtual Communities

For many, Silk Road represented not only a gateway to substances, but also a very tight-knit global community. In fact, much of the value proposition that Silk Road offered to its users was found in its forums, which were linked directly on the main website. Silk Road began by creating a barrier to entry for users known as “the newbie boards”, which prevented new accounts from joining the larger conversations until they had spent some time understanding the community. From there, the site’s users were able to discuss all manner of topics, including reliability of vendors, safe use of drugs, and the economic viability of the Silk Road model. It was also an opportunity for the site administrators to interact directly with its customers.

The first step in joining Silk Road’s forums required that new users write at least 50 comments or posts on the newbie boards, a space on the site relegated to new users. Once this task was completed, that user was able to write posts and replies on the rest of the forum. While some users would simply write nonsense comments on “fast track” posts in order to improve their comment count quickly, the site suggested that new users take this time to ask questions and create discussions about the site, to give them an accurate depiction of the community before allowing them to join it. This feature illustrates one of the main aspects of Silk Road’s community, referred to as *limited membership* by Galston (2003), which is often lacking in most Internet forums. In his article, Galston states that “many founding members of on-line groups experience the rapid influx of newer

members as a loss of intimacy”, which Silk Road was able to curb through a small barrier to entry (Galston, 2003, p. 198).

For “full members”, the classification for users that had completed the 50 post requirement, discussions on the forum fell under a wide range of topics. Mostly, the forum was a place to learn, as well as discuss interesting topics with like-minded people. It was able to supply at least two of the three essential value types for any type of community: functional value and social value (Palazón, 2008). The former is defined as “the value derived from accomplishing some pre-determined instrumental purpose”, such as finding out about a bad vendor (Palazón, 2008, pg. 259). The latter is defined as “the consumer value of interpersonal connectivity”, fostered via conversations about the underlying philosophy of the site itself (Palazón, 2008, pg. 259).

The camaraderie built through the shared experience of the site helped to fulfill two of the other dimensions of community (Galston, 2003). It helped to create social norms, which “evolve through iteration over time and are enforced through moral suasion and group disapproval” in virtual communities in particular (Galston, 2003, pg. 199). It also created a sense of mutual obligation, which “engenders a willingness to sacrifice on [other members’] behalf” (Galston, 2003, pg. 200). While virtual communities are inherently limited in this respect, the binding principle of this forum is an illegal marketplace, creating a virtual version of “honor among thieves” that permeates the site’s culture.

Once one became a full member, additional discussion would enhance the user to higher status within the forum, with different levels depending on contribution. Other users were also able to vote on the quality of comments, which were reflected in the user’s “karma score”, made public below their username on every post. Also, vendors and site administrators were given unique status on their profiles, separating them from the rest of the users. This method of artificial social hierarchy might have helped to reduce the impact of deindividuation, defined as “tendency to make more extreme and more offensive statements on the Internet than they would in face-to-face situations” (Holtz, 2012, p. 56). While other issues with Internet forum analysis such as anonymity and privacy are inherent to the medium, deindividuation might have been partially mitigated.

High profile users, such as administrators, helped set the tone for the site’s discourse, leading discussions and disseminating information to the public. Their actions are consistent with the intent to create a digital *umma*, “an imagined community that works through minds, attitudes, and discourses” (Kirmayer, 2013, p. 172). Unlike traditional communities which are brought together through geography or familial ties, this community existed only in the users’ minds. It could likewise be defined as a recursive public, where morals and ideas are argued through the Internet rather than face-to-face (Kirmayer, 2013, p. 174). By creating a close knit community that allowed norms to be challenged and debated directly, the Silk Road administrators created a sense of trust and openness for their users.

Methods

This exploratory research analyses the behavior of the Dark Net user base surrounding the closure of Silk Road in October of 2013 with the intent of helping determine the future of the Dark Net markets. Within the broad topic of user reaction to the Silk Road closure, the following research questions form the basis of our examination:

- 1) To what did the Dark Net market users attribute the fall of Silk Road?

- 2) Did the users still believe in the viability of Dark Net markets, after Silk Road closure?
 - a) Does this opinion differ between forums?
 - b) What correlation, if any, does User Level have with opinion on Dark Net markets?
- 3) Was the general sentiment of the Dark Nets' forums positive or negative, after the Silk Road closure?
 - a) What correlation, if any, does User Level have with average sentiment?
- 4) Did the Karma and User Ranking Systems employed by Dark Net markets mitigate the deindividuation effect found in virtual communities?
 - a) Does the Karma system inadvertently promote certain viewpoints on Dark Net forums?

Understanding how Dark Net users reacted to the site's closure is an important factor in determining the viability of other potential markets. The future of an entire branch of the narcotic and contraband market depended on whether the Silk Road community had staying power after the collapse, assuming a new site would be created. While persistence of Silk Road had other determining factors, the continued existence of the community was necessary to the site's survival.

First, learning to what the users attributed the fall of the Silk Road site would allow us to stipulate how likely they would be to stay on the site. Depending on the answers provided in the discussion, we might find users saying that Silk Road was too risky or unstable to continue at the time of the collapse. However, if they believed that the closure was a singular phenomenon or the result of a fluke, they might have been more inclined to remain on the site. Although some magazines reported recently Silk Road failure due to captcha technology glitch on the Silk Road servers (Krebs, 2014), the users of the Silk Road forum were likely closer to the incident and might have had some unique insight into the site failure that someone on the outside would not have.

It is also important to determine users' outlook on the Dark Net as a whole after Silk Road closure. Since the numerous measures taken by Silk Road to prevent a seizure of the site ultimately failed, some users could have gone to more traditional avenues for obtaining their drugs. Alternatively, if users found that other competing sites were able to improve on Silk Road's mistakes, and reduced transaction risks, they might have abandoned the potential new Silk Road site and gone somewhere else, e.g., Agora. This could mean the end of the Silk Road site but not necessarily the Dark Net medium. If users have lost faith, then it would likely mean that this Silk Road phenomenon is an isolated historical incident. If not, then the closure could be seen as part of the ongoing narrative and development of Dark Net black markets.

Finally, the overall sentiment of these sites' users will speak to the effect of the closure. Before October 2013, the forum generated "information sourcing and exchange, user connectivity, identification of trusted and reliable sourcing routes, and mutual user supports" (Van Hout & Bingham, 2013, p. 389). If the general sentiment on the forums were positive after the fall, then Silk Road was still perceived as a viable transaction medium. However, if the security breach has caused the users to be pessimistic and to shut down discussion, then Silk Road had lost one of its most important community attributes, which could lead to loss of user base and lack of future Dark Net viability.

To explore the research questions, we used content analysis as the primary method of investigation in this study (Crowley & Delfico, 1996, p. 6). Content analysis offers the most direct way of analyzing the opinions of the users short of interviews or surveys, which would have been nearly impossible to secure on such an anonymous website. About a week after the site's closure on October 2, 2013, the site's users created a new forum, <http://silkroad5v7dywlc.onion>, to discuss their theories about the arrest, the potential for new markets, and how the community could survive the closure. This research examines the contributions from that forum, as well as those of two competing markets Agora (<http://lacbzxobeprrsrfx.onion>) and Evolution (<http://i25c62nvu4cgeqyz.onion>) during five months following the site's closure, providing a large enough sample for the analysis and showing the immediate reactions of the community.

The forum was accessed via the Tor browser. We used the URLs above and one of the principal investigators (PIs) made an account on the sites. In order to participate in the discussions on Silk Road 2.0 and Agora that pertained to this research, the lead author first had to post 50 comments on the “newbie boards”, which acted as a deterrent to unwanted visitors. Once he got through that barrier, he was permitted to view the rest of the forum freely as a Full User. Four of the top viewed and commented posts from each site pertaining to the topic are analyzed in their entirety to answer research questions. Posts were first filtered by finding titles that pertained directly to one of the research questions (e.g. “There was a snitch against DPR” or “Will the new Silk Road be successful?”). Then, the post would need to have at least 15 comments.

The study also connects the type of user with the comments made. Alongside every comment on the forum is a brief summary of the user, including their classification (newbie, junior member, and full member) and their karma score (which indicates the community's opinion of their contributions). User classifications are based on the number of posts they have made, as follows:

- Newbie = <50 posts
- Junior Member = 50-99 posts
- Full Member = 100-149 posts
- Senior Member = 150-499 posts
- Hero Member = 500 posts and over
- Site Administrator (special designation)

Tracking these user designations demonstrates whether there is any correlation between user type and comment content. For example, the analysis will show whether there is any significant correlation between a user's karma score and their opinion on the viability of Dark Net as framed in research question two. The first question (“To what did the Dark Net market users attribute the fall of Silk Road?”) has many possible answers, and this research captures the broadest spectrum of answers possible, so that the variety and nuance of the forum users' views can be incorporated into the analysis. We examine if users thought that law enforcement was primarily responsible for the site's closure or if the seizure was partially the result of a competing website. The FBI could have used a high-tech IP tracking solution through Tor, or it could have been the result of traditional detective work. Also, some believe that the real head of Silk Road is still out there, and

that Ross Ulbright (the person arrested) was set up. Lastly, we included categories for those that were remaining undecided, as well as those proposing some other theory.

The second question (“Did the users still believe in the viability of Dark Net markets, after the Silk Road closure?”) likewise has considerable nuance. Now that it has been shown conclusively that sites of this kind are legally vulnerable, it is possible that some users would like to leave the medium entirely and go back to in-person transactions. Then, there are some others that would prefer to stay on the Dark Net, but avoid Silk Road. There might also be a group that believes in the Silk Road and its leadership, and will follow them as they begin development of a new site. Further statistical analysis of the correlation between popular opinion on this question and the comments’ source helps determine if the majority opinion about Silk Road’s viability as a market is different between Agora, Evolution, and Silk Road.

The third research question (“Was the general sentiment of the Dark Nets’ forums positive or negative, after the Silk Road closure?”) is intended to be a more subjective reading of the community’s temperament, and involves a sentiment analysis of each post’s comments. In this case, it is important to not only learn what the community’s general opinion of the seizure is, but what impact it has had on what was a very cohesive group. While the seizure could strengthen the resolve of some users, others could be more hostile or suspicious. Comments that are hopeful or joking in nature are coded as positive, intentionally rude or incendiary comments are coded as negative, and all others are coded as neutral. Also, analysis of the data will uncover any noticeable difference in attitude based on individual user level.

The fourth research question (“Did the Karma and User Ranking Systems used by Dark Net markets mitigate the de-individuation effect found in virtual communities?”) ties back the statistical data gathered from the forums to the Holtz (2012) paper regarding the analysis of Internet forums. In particular, Holtz argues that deindividuation on Internet forums often fosters extreme opinions and a higher rate of inflammatory comments than one would experience in reality. The karma score and user ranking system on Silk Road and Agora’s forums exist in part to mitigate such an effect by rewarding positive participation. This research correlates karma score and user ranking to comment sentiment after the Silk Road itself had closed. Analysis of these comments should help determine whether the forum’s ranking system mitigates deindividuation independent of the Silk Road marketplace. Correlation analysis between average karma score and the Dark Net market viability opinions found in question two will also show whether any bias exists towards certain opinions, or if the karma system functions purely as a promoter of positive behavior.

We used an Excel sheet to document all coding, with accompanying hard copies of the forum posts to verify data. The study used two coders to establish inter-coder reliability with the interpretation of the data. The coders disagreed on six comments in a total of 242, resulting in an inter-coder reliability of 97.521%. It is important to note that the legal context of this topic has greatly limited the options of methodology. A comparative analysis of the forum before and after the site’s closure would have required access to the original forum, which was deleted immediately following the Silk Road’s shutdown. Comparisons between the forum theories and the actual facts of the case would have required access to the FBI’s evidence and subpoenaed records, most of which were classified. Also, our attempts at direct interviews with internet law enforcement officials

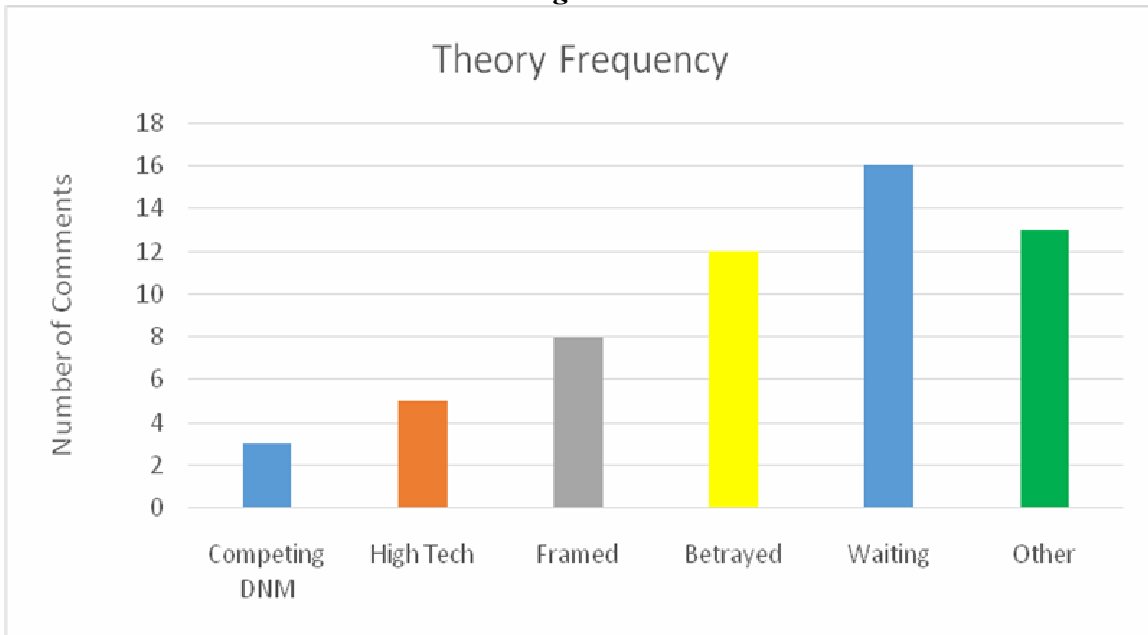
were all rejected, since the case was still ongoing during the research time frame. Most likely, anybody with the ability to clarify or verify any information on the forum was legally obligated not to do so, especially until the case has reached completion.

Findings

Demographic analysis of the forums shows that the mean user level of all contributors in the posts analyzed is 2.913, or slightly below Full Member status. When broken down into each individual forum, the lowest average is Silk Road with 2.457. By contrast, Evolution has the most experienced users with a mean of 3.345. This difference in experience level suggests a disparity in knowledge about Dark Net markets between forums. In other words, the average Silk Road user is likely less knowledgeable than the average user on Agora or Evolution. What follows is the presentation of research questions with our findings.

1. To what did the Dark Net market users attribute the fall of Silk Road?

Figure 3



Opinions on the way in which Silk Road was closed by the FBI varied considerably. The majority of users commenting on the seizure were on Silk Road's forums. Since the preliminary news reports and the FBI's own affidavit did identify a cooperating witness in the arrest, their identity was kept a secret. This led 12 users (*see Figure 3*), or 21% of all relevant comments, to speculate that this person had particularly close ties with Ulbricht, likely another site administrator or high level vendor. A smaller group of users believed that Ulbricht was not the true mastermind behind Silk Road at all, which explained why the Silk Road 2.0 came online as quickly as it did. Still, the majority of users (28%) that weighed in on the issue were still waiting for more facts to emerge, showing a more skeptical, mature stance than those positing conspiracies.

2. Did the users still believe in the viability of Dark Net markets, after the Silk Road closure?

Figure 4

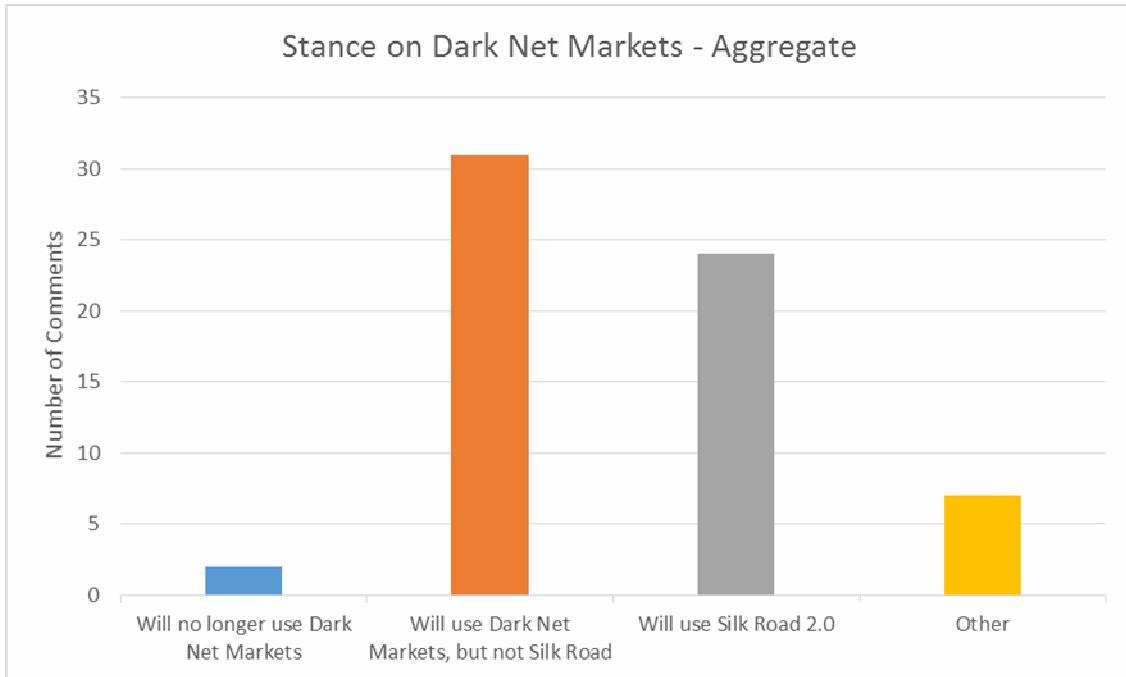
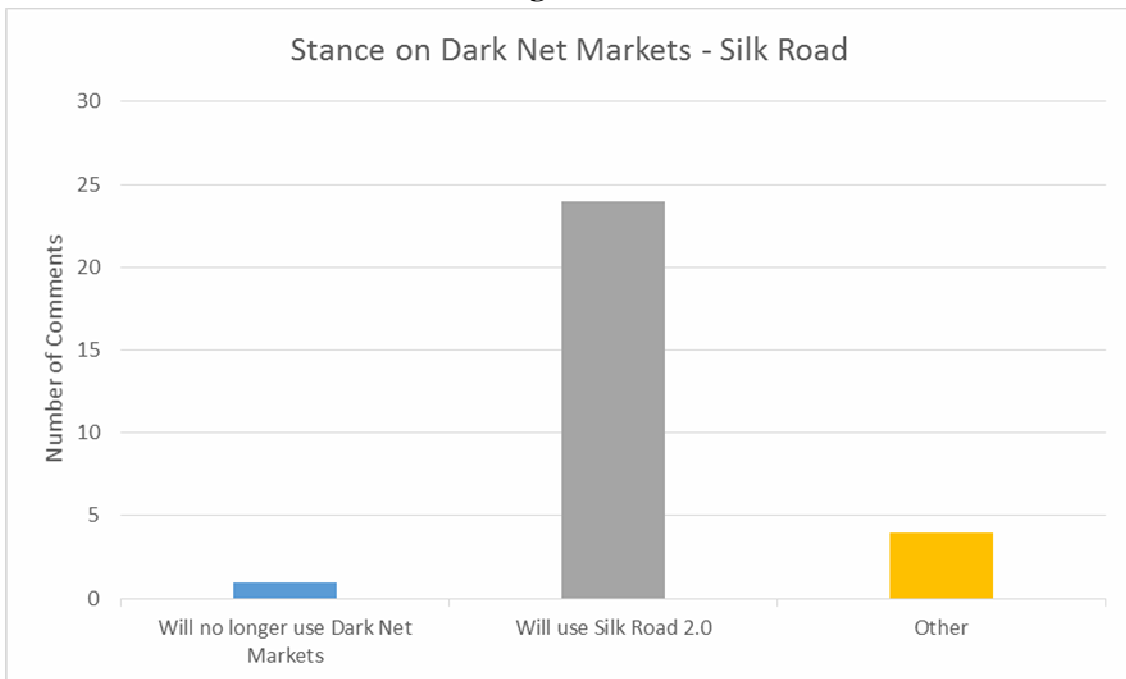


Figure 5



2a. Does this opinion differ between forums?

Figure 6

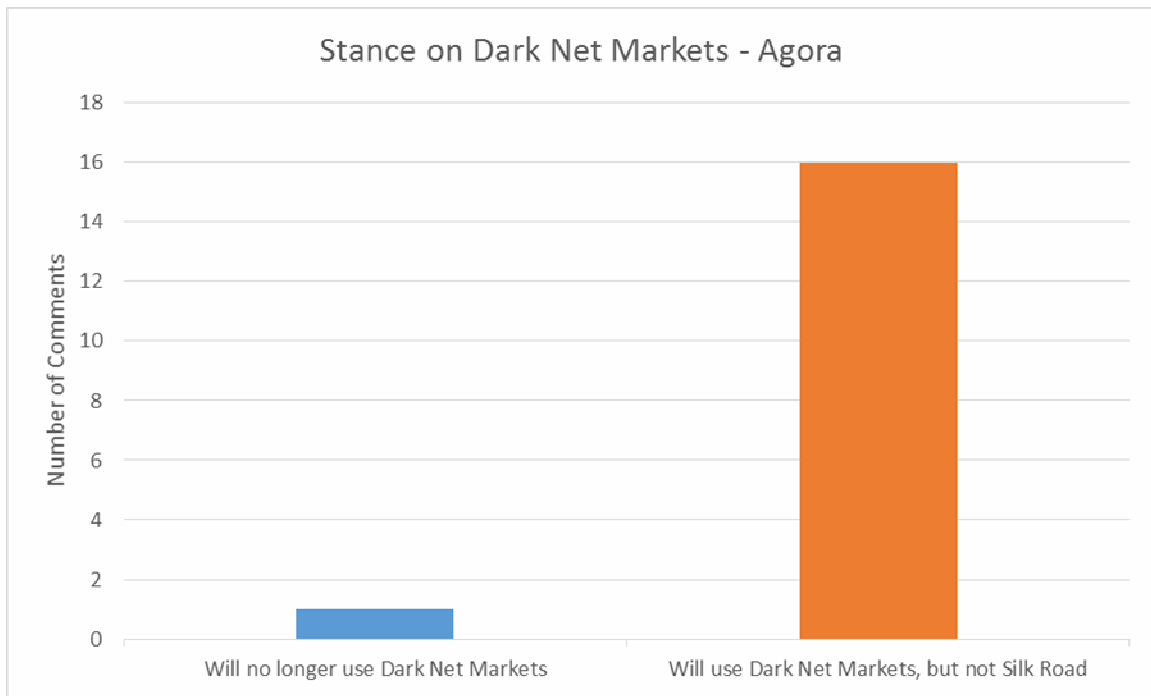
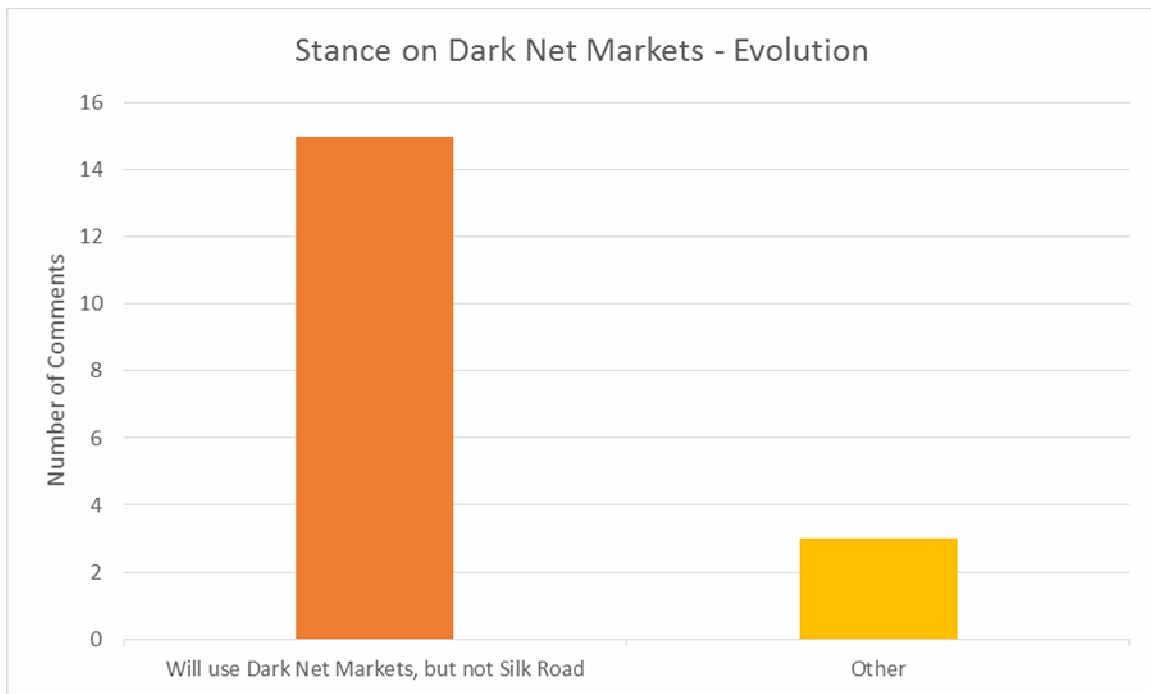


Figure 7



Popular opinion on Dark Net markets has shifted away from Silk Road and towards other markets. While many still believe that the Dark Net is a viable medium to buy drugs, Figure 4 indicates that the majority of users would like to use Dark Net markets, but not Silk Road.

When broken down into individual forums, it appears in Figure 5 that all of Silk Road’s supporters after the site’s seizure were confined to the Silk Road 2.0. At first glance, this data would indicate that Silk Road 2.0 has maintained its popularity through the seizure. However, when added to the data collected from Agora and Evolution in Figures 6 and 7, the result is that most users would prefer to move to a new market.

2b. What correlation, if any, does User Level have with opinion on Dark Net markets?

Figure 8

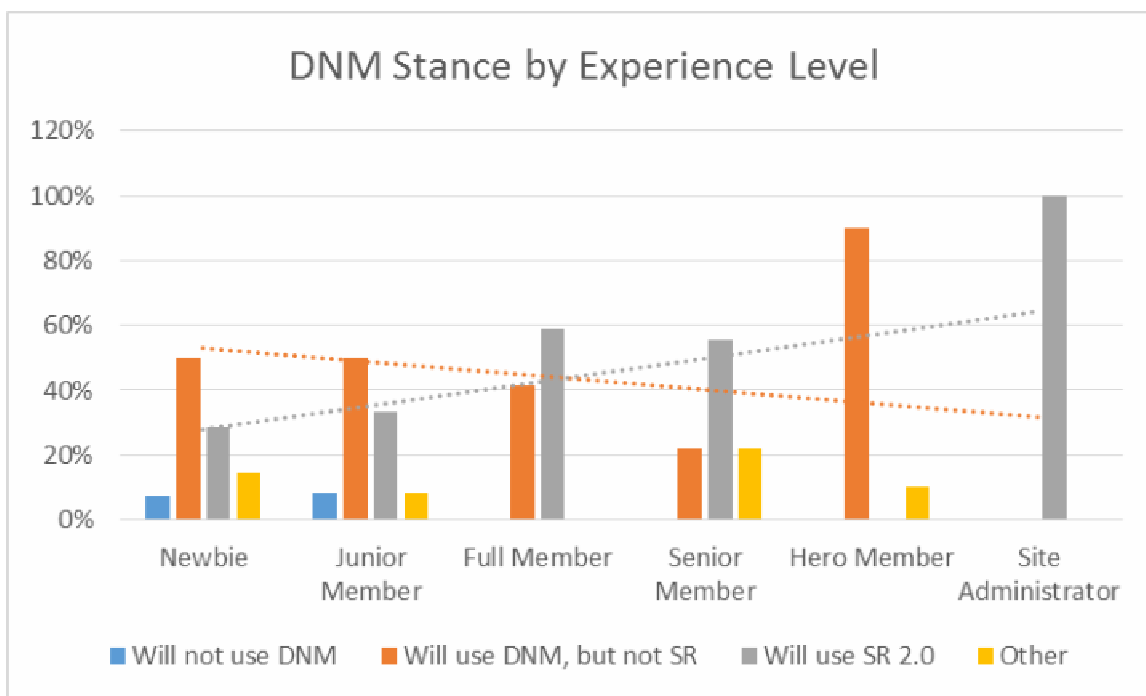
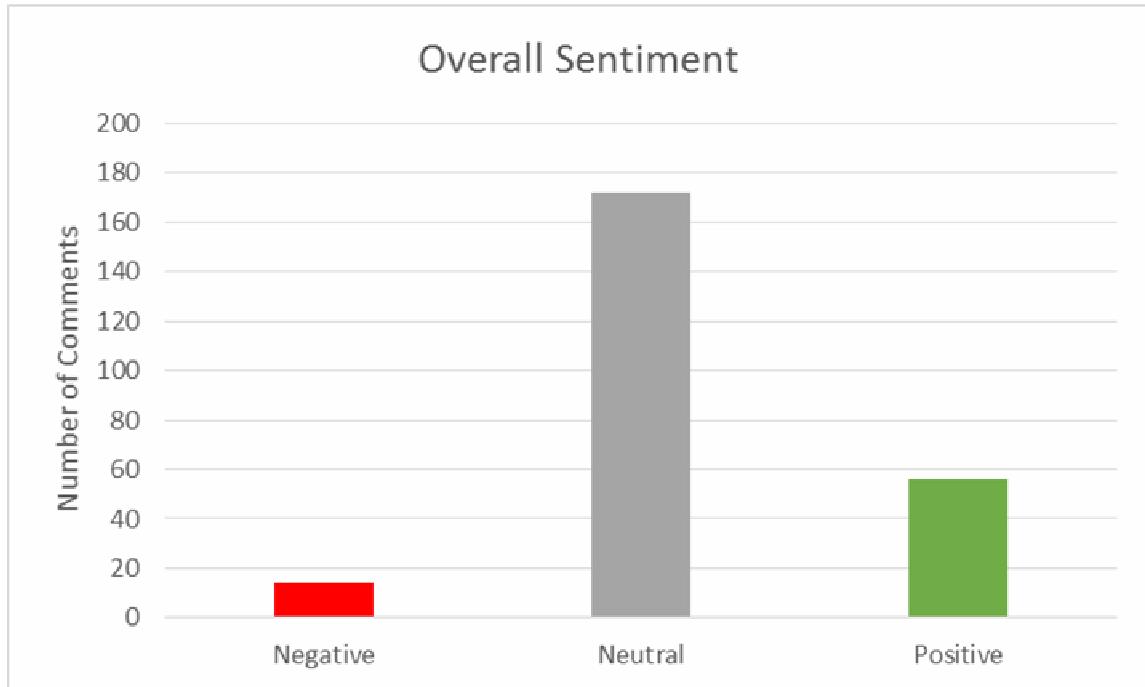


Figure 8 displays the correlation between user opinion on Dark Net markets and experience level. The data indicates that, as users begin to approach the status of Senior Member, they become less trustworthy of Silk Road and more likely to move elsewhere.

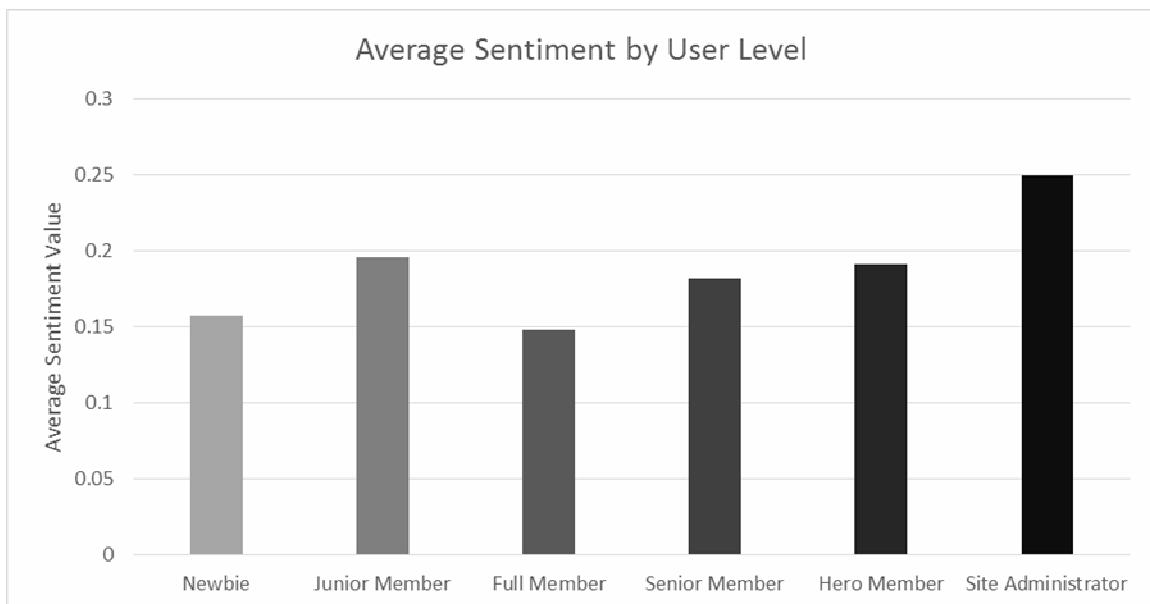
3. Was the general sentiment of the Dark Nets' forums positive or negative, after the Silk Road closure?

Figure 9



3a. What correlation, if any, does User Level have with average sentiment?

Figure 10³



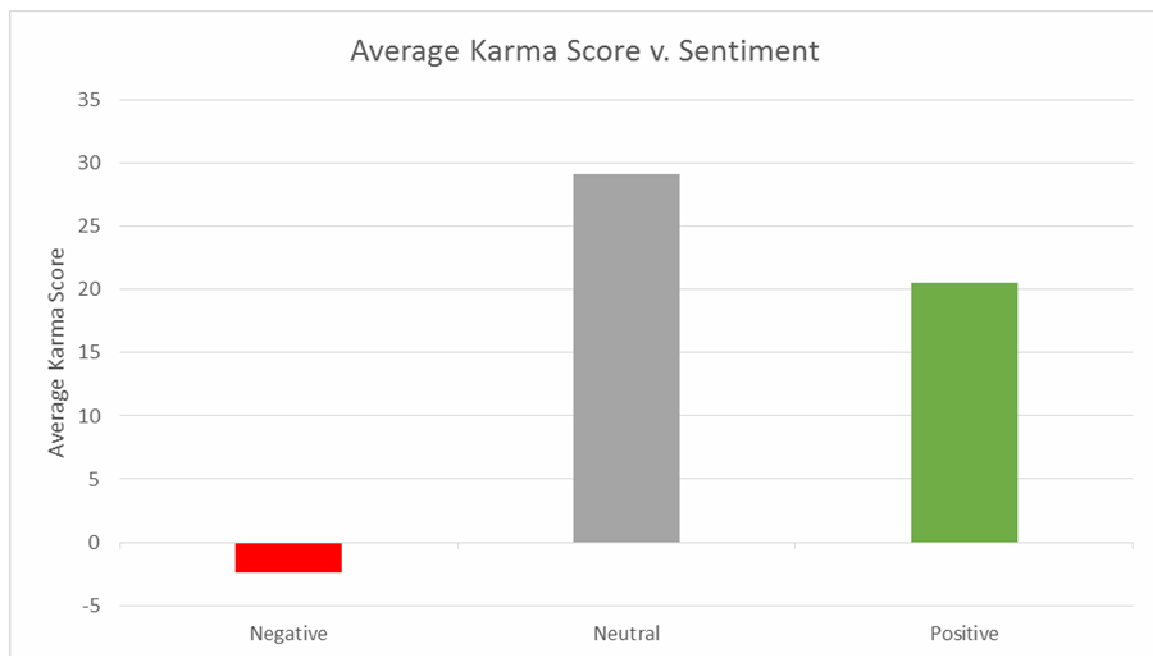
³ The closer "Average Sentiment Value" is to 1, the more generally positive the group.

Figure 9 shows the frequency of different sentiments on all of the Dark Net forums. The vast majority of comments (172 out of 242) are neutral. Most comments that did exhibit sentiment were positive in nature, with a final count of 56.

When sentiment is correlated against user level, a trend appears that reflects a typical user’s journey through the forums. At the beginning (see Figure 10), most posts tend not to exhibit any sentiment at all, as new members are typically still finding their way through the market. Then, as they get familiar, they begin to be more positive among their peers. Full Members, who comprise a majority of the forums, experience a dip in sentiment. From then on, there is a steady increase in positivity as the more experienced users get greater recognition from their peers.

4. Did the Karma and User Ranking Systems used by Dark Net markets mitigate the deindividuation effect found in virtual communities?

Figure 11



The average karma score for each type of sentiment (see Figure 11) indicates that Silk Road’s systems do help mitigate deindividuation. The highest rated comments are those that remain neutral, with an average of 29.198. Comments with a positive outlook fall slightly below, with an average of 20.513. Most importantly, rude or inflammatory comments correlate with a karma score of -2.444. It is important to note that certain users (such as site administrators or experienced vendors) tend to remain neutral in the forums for reasons of diplomacy, likely pulling the average karma for neutral comments up.

4a. Does the Karma system inadvertently promote certain viewpoints on Dark Net forums?

Figure 12

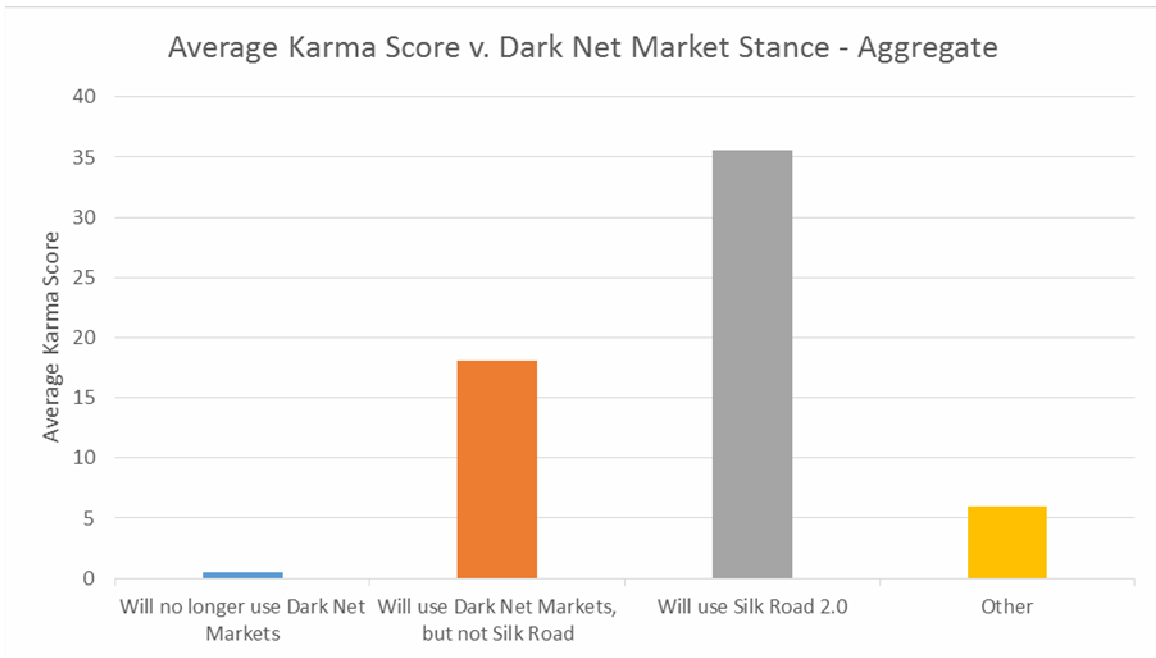
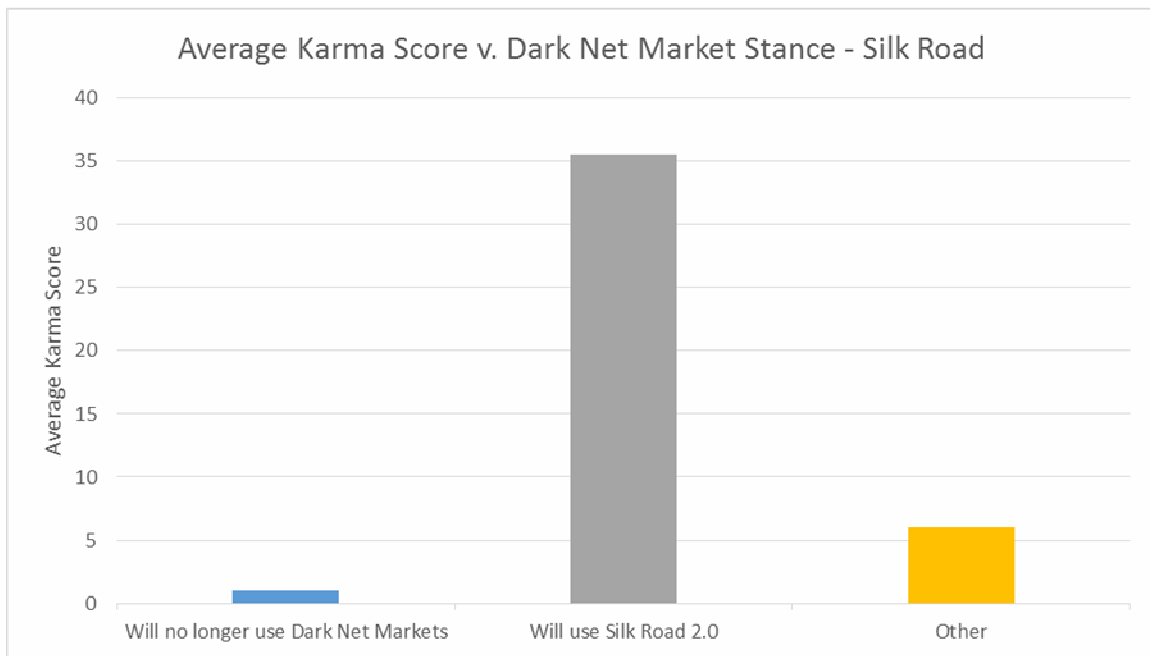
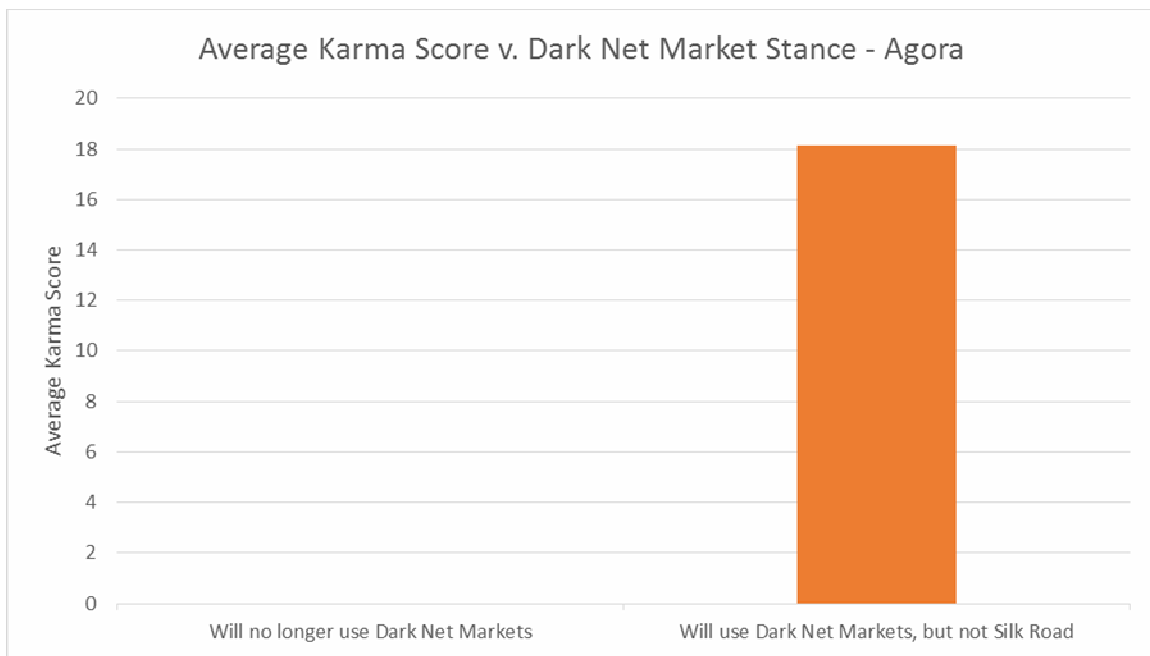


Figure 13



While the karma system can help to generate meaningful debate online, an unintended consequence of that system can be that certain opinions are rewarded with high karma. Figure 12 indicates that users staying with Silk Road 2.0 enjoy a 15 point boost in karma as compared with users choosing to leave. Figures 13 and 14 show how these correlations are distributed between the two sites, Silk Road 2.0 and Agora, that use a karma system.

Figure 14⁴



Discussion and Conclusion

During the process of writing and collecting data for this research, the state of the Dark Net and the legal case surrounding Silk Road has already changed dramatically. For example, the first research question (“To what did the Dark Net market users attribute the fall of Silk Road?”) can now be settled as a matter of record. According to *Business Insider* (Bertrand, 2015), the investigation was led by Jared Der-Yeghiayan, an agent for the Department of Homeland Security. Der-Yeghiayan and his team created false accounts to gain access to the site, and completed fake deals to gain Ulbricht’s trust.

This result proves 21% of those commenters correct. The factual findings show that the community built by Silk Road was a well-informed and perceptive one. More important still is the majority of commenters for the first question, who chose to wait for additional facts to emerge. While many people would have jumped to conclusions and thought emotionally, the choice to remain skeptical and unbiased is a mature reaction that speaks to the strength of the community too.

The second question (“Did the users still believe in the viability of Dark Net markets, after the Silk Road closure?”) has likewise been decided, at least partially. In the year following Silk Road’s initial closure, Agora and Evolution remained the two largest

⁴ Average Karma Score for “Will no longer use Dark Net markets” is 0.

markets, in part because they were the oldest among the markets that are still active and have retained many of the old users of Silk Road. By contrast, Silk Road 2.0 collapsed by November 2014. As of March 2015, Evolution was also closed – as a result of a scam by its operators, and as of September 2015, so was Agora, due to a server bug.

Beyond the stories of those three markets, as of September 2015, there are 22 more Dark Net markets listed on DNStats.net, a data aggregator for Dark Net markets, with over 46,000 drugs listed for sale, as compared to 18,000 in October 2013, when original Silk Road was closed (T.W. and The Data Team, 2015). This outgrowth, and the noticeable absence of any direct Silk Road successor, suggests that the users with a lower level of experience were correct in general in their opinion of the future of Dark Nets. The medium has grown, but Silk Road itself has failed to remain relevant.

What the results of the second research question show is that the majority of commenters, when aggregated, were correct in their assessment. Dark Net marketplaces have expanded considerably, while Silk Road itself has dissolved. This suggests, just as the results of the previous question did, that the users in this case were able to see a trend coming before it happened. The correlation between user level and opinion on Dark Net markets shows that the less experienced users were able to be more objective in their opinion, as they were more accurate, on average, than their more experienced counterparts.

The sentiment analysis conducted in question three reveals yet another strength of the community: the ability to remain positive and productive in the face of adversity. Despite what could be considered a catastrophic event, the majority of comments were neutral and positive comments outweighed negative ones. Further correlation analysis between sentiment and user level reveals who specifically was responsible for the mood: relatively inexperienced users combined with administrators and other high-level contributors.

The user level and karma system addressed in question four remains a fixture in other successful forums. The results show a positive correlation between user level and accuracy of opinion on the Dark Net's future. It also appears that karma helps generate more positive and productive discussion on the site. Given the high degree of value placed on the camaraderie aspect of Dark Net market forums, the ability to regulate and improve discussion quality is an important asset for any website intending to derive value from that discussion.

Notably, both karma and specified user levels also have their downsides in the formation of good community. Figures 13 and 14 illustrate the way in which karma can be used to disproportionately favor certain opinions, rather than help create an environment where all serious arguments can be discussed on equal footing. A greater emphasis on the site's front pages and in FAQ's about the purpose of karma would help to mitigate this effect, but ultimately it is a form of bias inherent to the medium.

One of the possible reasons for Silk Road's fall from relevancy, and for the popularity of older and more established markets can be traced to the theory of instable capitalism (Schumpeter, 1928, p. 365-366). It posits that the system of unrestrained capitalism retains a certain amount of instability that needs to be managed by government. Without this overseeing authority, market alternatives with higher levels of stability will outperform those with lower levels of stability. Agora, for example, has gained popularity in part for its consistent update and refinement of site security. Users were willing to tolerate Agora's significant level of downtime (84.12% as of March 2015) in exchange for the assurance of

stability (DNStats.net). By contrast, Silk Road's abrupt collapse hurt its reputation past the point of recovery.

As for the Ross Ulbricht case, he has been convicted on charges of conspiracy, money laundering, and narcotics trafficking. His sentencing took place on May 29, 2015, with another trial waiting for a murder-to-hire plot in Baltimore. As a point of interest, another case is currently pending in the San Francisco federal court against two FBI agents accused of stealing bitcoin. The agents allegedly took over \$1 million worth of bitcoin for themselves out of the \$33 million amount seized in the closure of Silk Road.

In conclusion, the future is uncertain, but the social mechanisms at work in Dark Net forums can be isolated and explained through data analysis, reinforcing theories of instable capitalism and online community building. The unique nature of Dark Net markets as highly anonymous and secretive, as well as loyal and intelligent, makes them an ideal test case for the unrestrained online marketplace. Silk Road's fall shows the limits of such a system, especially in the hands of negligent administrators. At the same time, the second wave of markets that has followed also shows that certain aspects of Silk Road's model worked exactly as intended. Time and additional analysis will tell whether Silk Road's fall represents an omen of Dark Net market collapse, or merely a step towards a uniquely modern, unrestricted revolution.

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