

Understanding the Incel Community on YouTube

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Abstract

YouTube is by far the largest host of user-generated video content worldwide. Alas, the platform also hosts inappropriate, toxic, and hateful content. One community that has often been linked to sharing and publishing hateful and misogynistic content is the so-called Involuntary Celibates (Incels), a loosely defined movement ostensibly focusing on men’s issues. In this paper, we set out to analyze the Incel community on YouTube by focusing on this community’s evolution over the last decade and understanding whether YouTube’s recommendation algorithm steers users towards Incel-related videos. We collect videos shared on Incel communities within Reddit and perform a data-driven characterization of the content posted on YouTube. Among other things, we find that the Incel community on YouTube is getting traction and that during the last decade, the number of Incel-related videos and comments rose substantially. We also find that users have a 6.3% of being suggested an Incel-related video by YouTube’s recommendation algorithm within five hops when starting from a non Incel-related video. Overall, our findings paint an alarming picture of online radicalization: not only Incel activity is increasing over time, but platforms may also play an active role in steering users towards such extreme content.

1 Introduction

While YouTube has revolutionized the way people discover and consume video content online, it has also enabled the spread of inappropriate and hateful content. The platform, and in particular its recommendation algorithm, has been repeatedly accused of promoting offensive and dangerous content, and even for helping radicalize users [49, 60, 63].

One fringe community active on YouTube are the so-called Involuntary Celibates, or *Incels* [42]. While not particularly structured, Incel ideology revolves around the idea of the “blackpill” – a bitter and painful truth about society – which roughly postulates that life trajectories are determined by how attractive one is. For example, Incels often deride the alleged rise of *lookism*, whereby things that are largely out of personal control, like facial structure, are more “valuable” than those under our control, like the fitness level. Incels are one of the most extreme communities of the Manosphere [7], a larger collection of movements discussing men’s issues [25] (see Section 2).

When taken to the extreme, these beliefs can lead to a dystopian outlook on society, where the only solution is a radical, potentially violent shift towards traditionalism, especially in terms of women’s role in society [15].

Overall, Incel ideology is often associated with misogyny, alt-right ideology, and anti-feminist viewpoints, and it has also been linked to multiple mass murders and violent offenses [12, 69]. In May 2014, Elliot Rodger killed six people and himself in Isla Vista, CA. This incident was a harbinger of things to come. Rodger uploaded a video on YouTube with his “manifesto,” as he planned to commit mass murder due to his belief in what is now generally understood to be Incel ideology [71]. He served as an apparent “mentor” to another mass murderer who shot nine people at Umpqua Community College in Oregon the following year [64]. In 2018, another mass murderer drove his van into a crowd in Toronto, killing nine people, and after his interrogation, the police claimed he had been radicalized online by Incel ideology [11]. Thus, while the concepts underpinning Incels’ principles may seem absurd, they also have grievous real-world consequences [8, 29, 53].

Motivation. Online platforms like Reddit became aware of the problem and banned several Incel-related communities on the platform [28]. However, prior work suggests that banning subreddits and their users for hate speech does not solve the problem, but instead makes these users someone else’s problem [13], as banned communities migrate to other platforms [51]. Indeed, the Incel community around several banned subreddits ended up migrating to various other online communities via a loosely connected network of new subreddits, blogs, stand-alone forums, and YouTube channels [58, 59].

The research community has mostly studied the Incel community and the broader Manosphere on Reddit, 4chan, and online discussion forums like Incels.me or Incels.co [20, 35, 46, 50, 58, 59]. However, the fact that YouTube has been repeatedly accused of user radicalization and promoting offensive and inappropriate content [37, 49, 52, 60, 63] prompts the need to study the extent to which Incels are exploiting the YouTube platform to spread their views.

Research Questions. With this motivation in mind, this paper explores the footprint of the Incel community on YouTube. More precisely, we identify two main research questions:

1. **RQ1:** How has the Incel community grown on YouTube over the last decade?

2. **RQ2:** Does YouTube’s recommendation algorithm contribute to steering users towards Incel communities?

Methods. We collect a set of 6.5K YouTube videos shared on Incel-related subreddits (e.g., /r/incels, /r/braincels, etc.), as well as a set of 5.7K random videos as a baseline. We then build a lexicon of 200 Incel-related terms via manual annotation, using expressions found on the Incel Wiki. We use the lexicon to label videos as “*Incel-related*,” based on the appearance of terms in the transcript, which describes the video’s content, and comments on the videos. Next, we use several tools, including temporal and graph analysis, to investigate the evolution of the Incel community on YouTube and whether YouTube’s recommendation algorithm contributes to steering users towards Incel content. To build our graphs, we use the YouTube Data API, which lets us analyze YouTube’s recommendation algorithm’s output based on video item-to-item similarities, as well as general user engagement and satisfaction metrics [74].

Main Findings. Overall, our study yields the following main findings:

- We find an increase in Incel-related activity on YouTube over the past few years and in particular concerning Incel-related videos, as well as comments that include pertinent terms. This indicates that Incels are increasingly exploiting the YouTube platform to broadcast and discuss their views.
- Random walks on the YouTube’s recommendation graph using the Data API and without personalization reveal that with a 6.3% probability a user will encounter an Incel-related video within five hops if they start from a random non Incel-related video posted on Reddit. Simultaneously, Incel-related videos are more likely to be recommended within the first two to four hops than in the subsequent hops.
- We also find a 9.4% chance that a user will encounter an Incel-related video within three hops if they have visited Incel-related videos in the previous two hops. This means that a user who purposefully and consecutively watches two or more Incel-related videos is likely to continue being recommended such content and with higher frequency.

Overall, our findings indicate that the threat of recommendation algorithms nudging users towards extreme content is real and that platforms and researchers need to address and mitigate these issues.

Paper Organization. We organize the rest of the paper as follows. The next section presents an overview of Incel ideology and the Manosphere and a review of the related work. Section 3 provides information about our data collection and video annotation methodology, while Section 4 analyzes the evolution of the Incel community on YouTube. Section 5 presents our analysis of how YouTube’s recommendation algorithm behaves with respect to Incel-related videos. Finally, we discuss our findings and possible design implications for social media platforms Section 6, and conclude the paper in Section 7.

2 Background & Related Work

Incels are a part of the broader “Manosphere,” a loose collection of groups revolving around a common shared interest in “men’s rights” in society [25]. While we focus on Incels, understanding the overall Manosphere movement provides relevant context. In this section, we provide background information about Incels and the Manosphere. We also review related work focusing on understanding Incels on the Web, YouTube’s recommendation algorithm and user radicalization, as well as harmful activity on YouTube.

2.1 Incels and the Manosphere

The Manosphere. The emergence of the so-called Web 2.0 and popular social media platforms have been crucial in enabling the Manosphere [43]. Although the Manosphere had roots in anti-feminism [21, 48], it is ultimately a *reactionary* community, with its ideology evolving and spreading mostly on the Web [25]. Coston et al. [16] argue about the growth of feminism: “If women were imprisoned in the home [...] then men were exiled from the home, turned into soulless robotic workers, in harness to a masculine mystique, so that their only capacity for nurturing was through their wallets.” Further, Blais et al. [9] analyze the beliefs concerning the Manosphere from a sociological perspective and refer to it as masculinism. They conclude that masculinism is: “a trend within the anti-feminist counter-movement mobilized not only against the feminist movement but also for the defense of a non-egalitarian social and political system, that is, patriarchy.” Subgroups within the Manosphere actually differ significantly. For instance, Men Going Their Own Way (MGTOWs) are hyper-focused on a particular set of men’s rights, often in the context of a bad relationship with a woman. These subgroups should not be seen as distinct units. Instead, they are interconnected nodes in a network of misogynistic discourses and beliefs [10]. According to Marwick and Lewis [43], what binds the manosphere subgroups is “the idea that men and boys are victimized; that feminists, in particular, are the perpetrators of such attacks.”

Overall, research studying the Manosphere has been mostly theoretical and qualitative in nature [25, 27, 30, 40]. These qualitative studies are important because they guide our study in terms of framework and conceptualization while motivating large-scale data-driven work like ours.

Incels. Incels are arguably the most extreme subgroup of the Manosphere [7]. Incels appear disarmingly honest about what is causing their grievances compared to other radical ideologies. They openly put their sexual deprivation, which is supposedly caused by their unattractive appearance, at the forefront, thus rendering their radical movement potentially more persuasive and insidious [46]. Incel ideology differs from the other Manosphere subgroups in the significance of the “involuntary” aspect of their celibacy. They believe that society is rigged against them in terms of sexual activity, and there is no solution at a personal level for the systemic dating problems of men [32, 47, 57]. Further, Incel ideology differs from, for example, MGTOW, in the idea of *voluntary* vs. *involuntary* celibacy. MGTOWs are *choosing* to not partake in sexual ac-

tivities, while Incels believe that society adversarially deprives them of sexual activity. This difference is crucial, as it gives rise to some of their more violent tendencies [25].

Incels believe to be doomed from birth to suffer in a modern society where women are not only able but encouraged to focus on superficial aspects of potential mates, e.g., facial structure or racial attributes. Some of the earliest studies of “involuntary celibacy” note that celibates tend to be more introverted and that, unlike women, celibate men in their 30s tend to be poorer or even unemployed [38]. In this distorted view of reality, men with these desirable attributes (colloquially nicknamed *Chads* by Incels) are placed at the top of society’s hierarchy. While a perusal of influential people in the world would perhaps lend credence to the idea that “handsome” white men are indeed at the top, the Incel ideology takes it to the extreme.

Incels rarely hesitate to call for violence [5]. This is often expressed in the form of self-harm incitement. For example, seeking advice by other Incels based on their physical appearance using the phrase “How over is it?,” they may be encouraged to “rope” (to hang oneself) or commit suicide [14]. Occasionally they also approach calls for outright genocide. Zimmerman et al. [75] associate Incel ideology to white-supremacy, highlighting how it should be taken as seriously as other forms of violent extremism.

2.2 Related Work

Incels and the Web. Massanari [44] performs a qualitative study of how Reddit’s algorithms, policies, and general community structure enables, and even supports, toxic culture. She focuses on the #GamerGate and Fappening incidents, both of which had primarily female victims, and argues that specific design decisions make it even worse for victims. For instance, the default ordering of posts on Reddit favors mobs of users promoting content over a smaller set of victims attempting to have it removed. She notes that these issues are exacerbated in the context of online misogyny because many of the perpetrators are extraordinarily techno-literate and thus able to exploit more advanced features of social media platforms.

Baele et al. [5] study content shared by members of the Incel community, focusing on how support and motivation for violence result from their worldview. Farrell et al. [20] perform a large-scale quantitative study of the misogynistic language across the Manosphere on Reddit. They create nine lexicons of misogynistic terms to investigate how misogynistic language is used in 6M posts from Manosphere-related subreddits. Jaki et al. [35] study misogyny on the Incels.me forum, analyzing users’ language and detecting misogyny instances, homophobia, and racism using a deep learning classifier that achieves up to 95% accuracy. Ribeiro et al. [58] perform a large-scale characterization of multiple Manosphere communities. They find that older Manosphere communities, such as Men’s Rights Activists and Pick Up Artists, are becoming less popular and active. In comparison, newer communities like Incels and MGTOWs attract more attention. They also find a substantial migration of users from old communities to new ones, and that newer communities harbor more toxic and extreme ideologies. In another study, Ribeiro et al. [59] investigate whether plat-

form migration of toxic online communities compromises content moderation focusing on /r/The_Donald and /r/Incels communities on Reddit. They conclude that a given platform’s moderation measures may create even more radical communities on other platforms. In contrast to the above studies, we focus on studying the Incel community on a video-sharing platform, aiming to quantify its growth over the last decade and the recommendation algorithm’s role.

Harmful Activity on YouTube. YouTube’s role in harmful activity has been studied mostly in the context of detection. Agarwal et al. [4] present a binary classifier trained with user and video features to detect videos promoting hate and extremism on YouTube, while Giannakopoulos et al. [24] develop a k-nearest classifier trained with video, audio, and textual features to detect violence on YouTube videos. Jiang et al. [36] investigate how channel partisanship and video misinformation affect comment moderation on YouTube, finding that comments are more likely to be moderated if the video channel is ideologically extreme. Sureka et al. [66] use data mining and social network analysis techniques to discover hateful YouTube videos, while Ottoni et al. [54] analyze video content and user comments on alt-right channels. Zannettou et al. [73] present a deep learning classifier for detecting videos that use manipulative techniques to increase their views, i.e., clickbait. Papadamou et al. [55], and Tahir et al. [67] focus on detecting inappropriate videos targeting children on YouTube. Mariconti et al. [41] build a classifier to predict, at upload time, whether or not a YouTube video will be “raided” by hateful users.

Calls for action. Additional studies point to the need for a better understanding of misogynistic content on YouTube. Wotanis et al. [72] show that more negative feedback is given to female than male YouTubers by analyzing hostile and sexist comments on the platform. Döring et al. [19] build on this study by empirically investigating male dominance and sexism on YouTube, concluding that male YouTubers dominate YouTube, and that female content producers are prone to receiving more negative and hostile video comments.

To the best of our knowledge, our work is the first to provide a large-scale understanding and analysis of misogynistic content on YouTube generated by the Manosphere subgroups. In particular, we investigate the role of YouTube’s recommendation algorithm in disseminating Incel-related content on the platform.

YouTube Recommendations. Covington et al. [17] describe YouTube’s recommendation algorithm, using a deep candidate generation model to retrieve a small subset of videos from a large corpus and a deep ranking model to rank those videos based on their relevance to the user’s activity. Zhao et al. [74] propose a large-scale ranking system for YouTube recommendations. The proposed model ranks the candidate recommendations based on user engagement and satisfaction metrics.

Others focus on analyzing YouTube recommendations on specific topics. Ribeiro et al. [60] perform a large-scale audit of user radicalization on YouTube: they analyze videos from Intellectual Dark Web, Alt-lite, and Alt-right channels, showing that they increasingly share the same user base. They also analyze YouTube’s recommendation algorithm finding that Alt-

right channels can be reached from both Intellectual Dark Web and Alt-lite channels. Stöcker et al. [65] analyze the effect of extreme recommendations on YouTube, finding that YouTube’s auto-play feature is problematic. They conclude that preventing inappropriate personalized recommendations is technically infeasible due to the nature of the recommendation algorithm. Finally, [31] focus on measuring misinformation on YouTube and perform audit experiments considering five popular topics like 9/11 and chemtrail conspiracy theories to investigate whether personalization contributes to amplifying misinformation. They audit three YouTube features: search results, Up-next video, and Top 5 video recommendations, finding a filter bubble effect [56] in the video recommendations section for almost all the topics they analyze. In contrast to the above studies, we focus on a different societal problem on YouTube. We explore the footprint of the Incel community, and we analyze the role of the recommendation algorithm in nudging users towards them. To the best of our knowledge, our work is the first to study the Incel community on YouTube and the role of YouTube’s recommendation algorithm in the circulation of Incel-related content on the platform. We devise a methodology for annotating videos on the platform as Incel-related and using several tools, including text and graph analysis. We study the Incel community’s footprint on YouTube and assess how YouTube’s recommendation algorithm behaves with respect to Incel-related videos.

3 Dataset

We now present our data collection and annotation process to identify Incel-related videos.

3.1 Data Collection

To collect Incel-related videos on YouTube, we look for YouTube links on Reddit, since recent work highlighted that Incels are particularly active on this platform [58]. We start by building a set of subreddits that can be confidently considered related to Incels. To do so, we inspect around 15 posts on the Incel Wiki [34] looking for references to subreddits and compile a list of 19 Incel-related subreddits. This list also includes a set of communities broadly relevant to Incel ideology (even possibly anti-incele like /r/Inceltears) to capture a broader collection of relevant videos. The list of subreddits and where on the Incel Wiki we find them is available anonymously from [1].

We collect all submissions and comments made between June 1, 2005, and April 30, 2019, on the 19 Incel-related subreddits using the Reddit monthly dumps from Pushshift [6]. We parse them to gather links to YouTube videos, extracting 5M posts, including 6.5K unique links to YouTube videos that are still online and have a transcript available by YouTube to download. Next, we collect the metadata of each YouTube video using the YouTube Data API [26]. Specifically, we collect: 1) transcript; 2) title and description; 3) a set of tags defined by the uploader; 4) video statistics such as the number of views, likes, etc.; and 5) the top 1K comments, defined by YouTube’s relevance metric, and their replies. Throughout the rest of this paper, we refer to this set of videos, which is derived from Incel-related subreddits, as “*Incel-derived*” videos.

Table 1 reports the total number of users, posts, linked YouTube videos, and the period of available information for each subreddit. Although recently created, /r/Braincels has the largest number of posts and YouTube videos. Also, even though it was banned in November 2017 for inciting violence against women [28], /r/Incels is fourth in terms of YouTube videos shared. Lastly, note that most of the subreddits in our sample were created between 2015 and 2018, which already suggests a trend of increasing popularity for the Incel community.

Control Set. We also collect a dataset of random videos and use it as a control to capture more general trends on YouTube videos shared on Reddit as the Incel-derived set includes only videos posted on Incel communities on Reddit. To collect Control videos, we parse all submissions and comments made on Reddit between June 1, 2005, and April 30, 2019, using the Reddit monthly dumps from Pushshift, and we gather all links to YouTube videos. From them, we randomly select 5,793 links shared in 2,154 subreddits for which we collect their metadata using the YouTube Data API. We provide a list of these subreddits and the number of control videos shared in each subreddit anonymously at [3].

Ethics. Note that we only collect publicly available data, make no attempt to de-anonymize users, and overall follow standard ethical guidelines [18, 61]. Also, our data collection does not violate the terms of use of the APIs we employ.

3.2 Video Annotation

The analysis of Incel-related content on YouTube differs from analyzing other types of inappropriate content on the platform. So far, there is no prior study exploring the main themes involved in videos that Incels find of interest. This renders the task of annotating the actual video rather cumbersome. Besides, annotating the video footage does not by itself allow us to study the footprint of the Incel community on YouTube effectively. When it comes to this community, it is not only the video’s content that may be relevant. Rather, the language that the community members use in their videos or comments for or against their views is also of interest. For example, there are videos featuring women talking about feminism, which are heavily commented on by Incels.

Building a Lexicon. To capture the variety of aspects of the problem, we devise an annotation methodology based on a lexicon of terms that are routinely used by members of the Incel community and use it to annotate the videos in our dataset. To create this lexicon, we first crawl the “glossary” available on the Incels Wiki page [33], gathering 395 terms. Since the glossary includes several words that can also be regarded as general-purpose (e.g., fuel, hole, legit, etc.), we employ three human annotators to determine whether each term is specific to the Incel community.

The annotators were told to consider a term relevant only if it expresses hate, misogyny, or is directly associated with Incel ideology. For example, the phrase “Beta male” or any Incel-related incident (e.g., “supreme gentleman,” an indirect reference to the Isla Vista killer Elliot Rodgers [71]). Annotators are authors of this paper. They are familiar with scholarly articles

Subreddit	#Videos	#Users	#Posts	Min. Date	Max. Date
Braincels	2,744	2,830,522	51,443	2017-10	2019-05
ForeverAlone	1,539	1,921,363	86,670	2010-09	2019-05
IncelTears	1,285	1,477,204	93,684	2017-05	2019-05
Incels	976	1,191,797	39,130	2014-01	2017-11
IncelsWithoutHate	223	163,820	7,141	2017-04	2019-05
ForeverAloneDating	92	153,039	27,460	2011-03	2019-05
askanincel	25	39,799	1,700	2018-11	2019-05
BlackPillScience	25	9,048	1,363	2018-03	2019-05
ForeverUnwanted	23	24,855	1,136	2016-02	2018-04
Incelselves	17	60,988	7,057	2018-07	2019-05
Truecels	15	6,121	714	2015-12	2016-06
gymcels	5	1,430	296	2018-03	2019-04
MaleForeverAlone	3	6,306	831	2017-12	2018-06
foreveraloneteens	2	2,077	450	2011-11	2019-04
gaycel	1	117	43	2014-02	2018-10
SupportCel	1	6,095	474	2017-10	2019-01
Truefemcels	1	311	95	2018-09	2019-04
Foreveralonelondon	0	57	19	2013-01	2019-01
IncelDense	0	2,058	388	2018-06	2019-04
Total	6,977	7,897,007	320,094	-	-

Table 1: Overview of our Reddit dataset. The total number of videos reported differs from the unique videos collected since multiple videos have been shared in more than one subreddit.

on the Incel community and the Manosphere in general and had no communication whatsoever about the task at hand.

We then create our lexicon by only considering the terms annotated as relevant, based on all the annotators’ majority agreement, which yields a 200 Incel-related term dictionary. We also compute the Fleiss’ Kappa Score [23] to assess the agreement between the annotators, finding it to be 0.69, which is considered “substantial” agreement [39]. The final lexicon with all the relevant terms is available anonymously from [2].

Labeling. Next, we use the lexicon to label the videos in our dataset. We look for these terms in the transcript, title, tags, and comments of our dataset videos. Most matches are from the transcript and the videos’ comments; thus, we decide to use these to determine whether a video is Incel-related. To select the minimum number of Incel-related terms that transcripts and comments should contain to be labeled as “Incel-related,” we devise the following methodology:

1. We randomly select 1K videos from the Incel-derived set, which the first author of this paper manually annotates as “Incel-related” or “Other” by watching them and looking at the metadata. Note that Incel-related videos are a subset of Incel-derived ones.
2. We count the number of Incel-related terms in the transcript and the annotated videos’ comments.
3. For each possible combination of the minimum number of Incel-related terms in the transcript and the comments, we label each video as Incel-related or not, and calculate the accuracy, precision, recall, and F1 score based on the labels assigned to the videos during the manual annotation.

Table 2 shows the performance metrics for the top five combinations of the number of Incel-related terms in the transcript

#Incel-related Terms in Transcript in Comments		Accuracy	Precision	Recall	F1 Score
≥ 0	≥ 7	0.81	0.77	0.80	0.78
≥ 1	≥ 1	0.82	0.78	0.82	0.79
≥ 0	≥ 3	0.79	0.79	0.79	0.79
≥ 1	≥ 2	0.83	0.78	0.83	0.79
≥ 1	≥ 3	0.83	0.79	0.83	0.79

Table 2: Performance metrics of the top combinations of the number of Incel-related terms in a video’s transcript and comments.

and the comments. We pick the one yielding the best F1 score (to balance between false positives and false negatives), which is reached if we label a video as Incel-related when there is at least one Incel-related term in the transcript and at least three in the comments.

Table 3 reports the label statistics of the Incel-derived videos per subreddit. Our final labeled dataset includes 290 Incel-related and 6,162 Other videos in the Incel-derived set and 66 Incel-related and 5,727 Other videos in the Control set.

4 RQ1: Evolution of Incel community on YouTube

This section explores how the Incel communities on YouTube and Reddit have evolved in terms of videos and comments posted.

4.1 Videos

We start by studying the “evolution” of the Incel communities concerning the number of videos they share. First, we look at the frequency with which YouTube videos are shared on

Subreddit	#Incel-related Videos	#Other Videos
Braincels	175	2,569
ForeverAlone	45	1,494
IncelTears	56	1,229
Incels	48	928
IncelsWithoutHate	16	207
ForeverAloneDating	0	92
askanincel	2	23
BlackPillScience	5	20
ForeverUnwanted	4	19
Incelselves	1	16
Truecels	1	14
gymcels	2	3
MaleForeverAlone	0	3
foreveraloneteens	0	2
gaycel	0	1
SupportCel	0	1
Truefemcels	0	1
ForeverAloneLondon	0	0
IncelDense	0	0
Total (Unique)	290	6,162
Control Set	66	5,727

Table 3: Overview of our labeled Incel-derived and Control videos dataset.

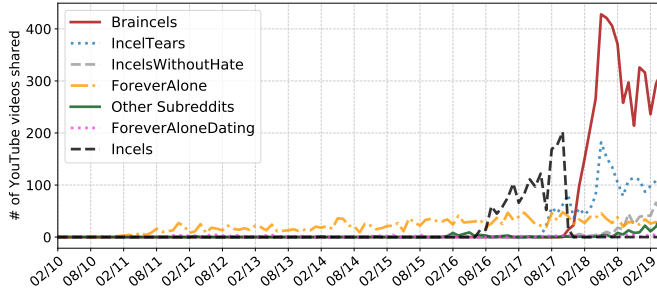


Figure 1: Temporal evolution of the number of YouTube videos shared on each subreddit per month.

various Incel-related subreddits per month; see Figure 1. After June 2016, we observe that Incel-related subreddits users start linking to YouTube videos more frequently and more in 2018. This trend is more pronounced on */r/Braincels*. This indicates that the use of YouTube to spread Incel ideology is increasing. Note that the sharp drop of */r/Incels* activity is due to Reddit’s decision to ban this subreddit for inciting violence against women in November 2017 [28]. However, the sharp increase of */r/Braincels* activity after this period questions the efficacy of Reddit’s decision to ban */r/Incels*. It also worths noting that Reddit decided to ban */r/Braincels* in September 2019 [62].

In Figure 2, we plot the cumulative percentage of videos published per month for both Incel-derived and Control videos. While the increase in the number of Other videos remains relatively constant over the years for both sets of videos, this is not the case for Incel-related ones, as 81% and 64% of them in the Incel-derived and Control sets, respectively, were published after December 2014. Overall, there is a steady increase in Incel

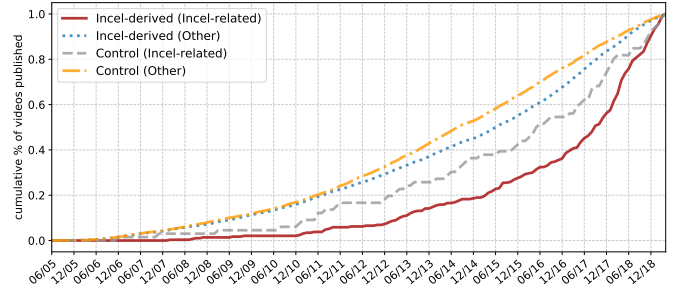


Figure 2: Cumulative percentage of videos published per month for both Incel-derived and Control videos.

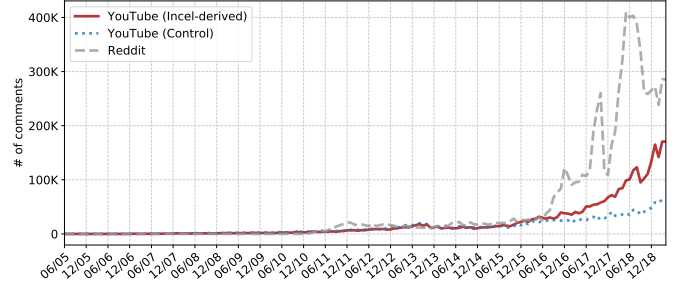


Figure 3: Temporal evolution of the number of comments per month.

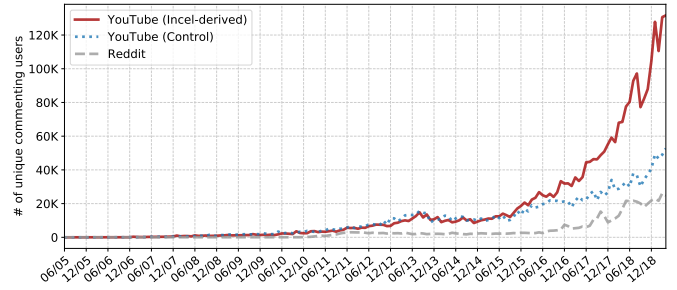


Figure 4: Temporal evolution of the number of unique commenting users per month.

activity, especially after 2016, which is particularly worrisome as we have several examples of users who were radicalized online and have gone to undertake deadly attacks [11].

4.2 Comments

Next, we study the commenting activity on both Reddit and YouTube. Figure 3 shows the number of comments posted per month for both YouTube Incel-derived and Control videos, and Reddit. Activity on both platforms starts to markedly increase after 2016, with Reddit and YouTube Incel-derived videos having substantially fewer comments than Control. Once again, the sharp increase in the commenting activity over the last few years signals an increase in the Incel user base’s size.

To further analyze this trend, we look at the number of *unique* commenting users per month on both platforms; see Figure 4. On Reddit, we observe that the number of unique users remains steady over the years, increasing from 10K in August 2017 to 25K in April 2019. This is mainly because most of the subreddits in our dataset (58%) were created after 2016. On the other hand, for the Incel-derived videos on YouTube, there is

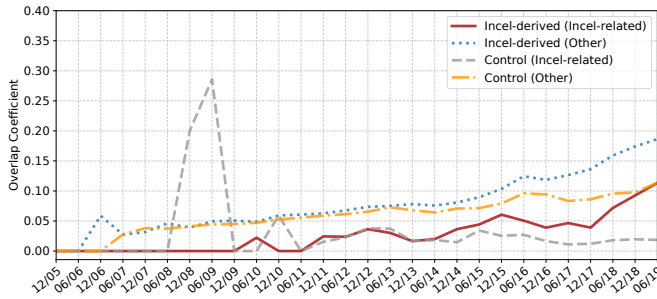


Figure 5: Self-similarity of commenting users in adjacent months for both Incel-derived and Control videos.

a substantial increase from 30K in February 2017 to 132K in April 2019. We also observe an increase of the Control videos’ unique commenting users (from 18K in February 2017 to 53K in April 2019). However, the increase is not as sharp as that of the Incel-derived videos; 483% vs. 1,040% increase in the average unique commenting users per month after January 2017 in Control and Incel-derived videos, respectively.

To assess whether the sharp increase in unique commenting users of Incel-related videos is due to the increased interest by newly acquired users or due to an increased interest in those videos and their discussions by the same users over the years, we use the Overlap Coefficient similarity metric [70]; it measures user retention over time for the videos in our dataset. Specifically, we calculate the similarity of commenting users with those doing so *the month before*, for both Incel-related and Other videos in the Incel-derived and Control sets. Note that if the set of commenting users of a specific month is a subset of the previous month’s commenting users or the converse, the overlap coefficient is equal to 1. The results of this calculation are shown in Figure 5. Interestingly, for the Incel-derived set, we find a sharp growth in user retention on Incel-related videos after 2017, while this is not the case for the Control. Once again, this might be related to the increased popularity of the Incel communities. Also, the higher user retention of Other videos in both sets is likely due to the much higher proportion of Other videos in each set.

5 RQ2: Does YouTube’s recommendation algorithm steer users towards Incel-related videos?

Next, we present an analysis of how YouTube’s recommendation algorithm behaves with respect to Incel-related videos. More specifically, 1) we investigate how likely it is for YouTube to recommend an Incel-related video; and 2) We simulate the behavior of a user who views videos based on the recommendations by performing random walks on YouTube’s recommendation graph to measure the probability of such a user discovering Incel-related content.

5.1 Recommendation Graph Analysis

To build the recommendation graphs used for our analysis, for each video in the Incel-derived and Control sets, we collect

Recommendation Graph	Incel-related	Other
Incel-derived	1,074 (2.85%)	36,673 (97.15%)
Control	428 (1.46%)	28,866 (98.54%)

Table 4: Number of Incel-related and Other videos in each recommendation graph.

the top 10 recommended videos associated with it, as returned by the YouTube Data API. We collect the recommendations for the Incel-derived videos between September 20, 2019, and October 4, 2019, and the Control between October 15, 2019, and November 1, 2019. Note that the use of the YouTube Data API is associated with a specific account only for authentication to the API. At the same time, the API does not maintain a watch history nor any cookies. Thus, our data collection does not capture how specific account features or the viewing history affect personalized recommendations. Instead, we quantify the recommendation algorithm’s item-to-item similarity and general user engagement aspects [74]. To annotate the videos, we follow the same approach described in Section 3.2. Since our video annotation is based on the videos’ transcripts, we only consider the videos that have one when building our recommendations graphs.

Next, we build a directed graph for each set of recommendations, where nodes are videos (either our dataset videos or their recommendations), and edges between nodes indicate the recommendations between all videos (up to ten). For instance, if *video2* is recommended via *video1*, then we add an edge from *video1* to *video2*. Throughout the rest of this paper, we refer to each set of videos’ collected recommendations as separate *recommendation graphs*.

First, we investigate the prevalence of Incel-related videos in each recommendation graph. Table 4 reports the number of Incel-related and Other videos in each graph. For the Incel-derived graph, we find 36,7K (97.1%) Other and 1K (2.9%) Incel-related videos, while in the Control graph, we find 28,9K (98.5%) Other and 428 (1.5%) Incel-related videos. These findings highlight that despite the proportion of Incel-related video recommendations in the Control graph being smaller, there is still a non-negligible amount recommended to users. Also, note that we reject the null hypothesis that the differences between the two graphs are due to chance via Fisher’s exact test ($p < 0.001$) [22].

How likely is it for YouTube to recommend an Incel-related Video?

Next, to understand how frequently YouTube recommends an Incel-related video, we study the interplay between the Incel-related and Other videos in each recommendation graph. For each video, we calculate the out-degree in terms of Incel-related and Other labeled nodes. We can then count the number of *transitions* the graph makes between differently labeled nodes. Table 5 reports the percentage of each transition between the different types of videos for both graphs. Perhaps unsurprisingly, most of the transitions, 93.2% and 97.0%, respectively, in the Incel-derived and Control graphs are between Other videos, but this is mainly because of the large number of Other videos in each graph. We also find a high percentage of transitions between Other and Incel-related videos. When a

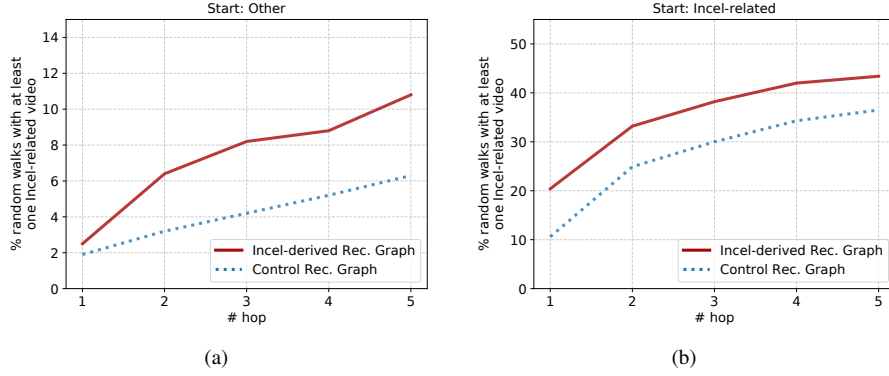


Figure 6: Percentage of random walks where the random walker encounters at least one Incel-related video for both starting scenarios.

Source	Destination	Incel-derived	Control
Incel-related	Incel-related	889 (0.79%)	89 (0.16%)
Incel-related	Other	3632 (3.23%)	773 (1.37%)
Other	Other	104,706 (93.17%)	54,787 (96.98%)
Other	Incel-related	3,160 (2.81%)	842 (1.49%)

Table 5: Number of transitions between Incel-related and Other videos in each recommendation graph.

user watches an Other video, if they randomly follow one of the top ten recommended videos, there is a 2.8% and 1.5% probability in the Incel-derived and Control graphs, respectively, that they will end up at an Incel-related video. In both graphs, Incel-related videos are more often recommended by Other videos than by Incel-related videos, but this is due to the large number of Other videos. This indicates that YouTube’s recommendation algorithm cannot discern Incel-related videos, which are likely misogynistic.

5.2 Does YouTube’s recommendation algorithm contribute to steering users towards Incel communities?

We then study how YouTube’s recommendation algorithm behaves with respect to discovering Incel-related videos. Through our graph analysis, we showed that the problem of Incel-related videos on YouTube is quite prevalent. However, it is still unclear how often YouTube’s recommendation algorithm leads users to this type of content.

To measure this, we perform experiments considering a “random walker.” This allows us to simulate a random user who starts from one video and then watches several videos according to the recommendations. The random walker begins from a randomly selected node and navigates the graph choosing edges at random for five hops. We repeat this process for 1,000 random walks considering two starting scenarios. In the first scenario, the starting node is restricted to Incel-related videos. In the second, it is restricted to Other. We perform the same experiment on both the Incel-derived and Control recommendations graphs.

Next, for the random walks of each recommendation graph, we calculate two metrics: 1) the percentage of random walks where the random walker finds at least one Incel-related video

in the k -th hop; and 2) the percentage of Incel-related videos over all unique videos that the random walker encounters up to the k -th hop for both starting scenarios. The two metrics, at each hop are shown in Figure 6 and 7 for both recommendation graphs.

When starting from an Other video, there is, respectively, a 10.8% and 6.3% probability to encounter at least one Incel-related video after five hops in the Incel-derived and Control recommendation graphs (see Figure 6(a)). When starting from an Incel-related video, we find at least one Incel-related in 43.4% and 36.5% of the random walks performed on the Incel-derived and Control recommendation graphs, respectively (see Figure 6(b)). Also, when starting from Other videos, most of the Incel-related videos are found early in our random walks (i.e., at the first hop), and this number remains almost the same as the number of hops increases (see Figure 7(a)). The same stands when starting from Incel-related videos, but in this case, the percentage of Incel-related videos decreases as the number of hops increases for both recommendation graphs (see Figure 7(b)).

As expected, in all cases, the probability of encountering Incel-related videos in random walks performed on the Incel-derived recommendation graph is higher than in the random walks performed on the Control recommendation graph. We also verify that the difference between the distribution of Incel-related videos encountered in the random walks of the two recommendation graphs is statistically significant via the Kolmogorov-Smirnov test [45] ($p < 0.05$). Overall, we find that Incel-related videos are usually recommended within the two first hops. However, in subsequent hops, the number of encountered Incel-related videos decreases. This indicates that in the absence of personalization (e.g., for a non-logged-in user), a user casually browsing YouTube videos is unlikely to end up in a region dominated by Incel-related videos.

5.3 Does the frequency with which Incel-related videos are recommended increases for users who choose to see the content?

So far, we have simulated the scenario where a user browses the recommendation graph randomly, i.e., they do *not* select Incel-related videos according to their interests or other cues nudging them to view certain content. Next, we simulate the

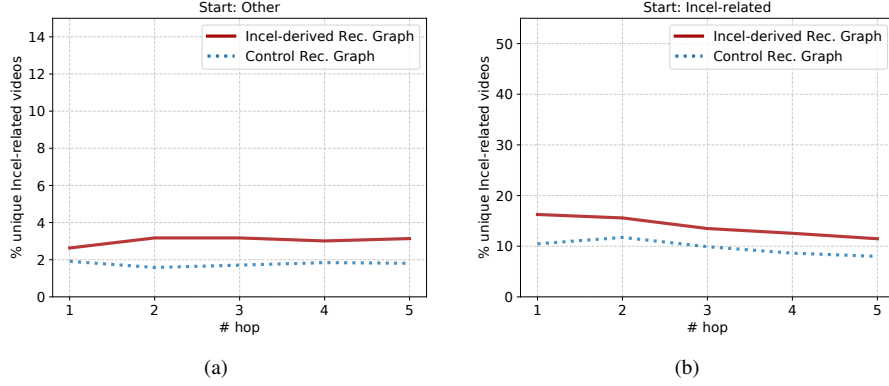


Figure 7: Percentage of Incel-related videos across all unique videos that the random walk encounters at hop k for both starting scenarios.

#hop (M)	Incel-derived Recommendation Graph		Control Recommendation Graph	
	In next 5-M hops, ≥ 1 Incel-related	In next hop, 1 Incel-related	In next 5-M hops, ≥ 1 Incel-related	In next hop, 1 Incel-related
1	43.4%	4.1%	36.5%	2.1%
2	46.5%	9.4%	38.9%	5.4%
3	49.3%	11.4%	41.6%	5.0%
4	49.7%	18.9%	42.0%	11.2%
5	47.9%	30.1%	39.7%	17.7%

Table 6: Probability of finding (a) at least one Incel-related video in the next $5 - M$ hops having already watched M consecutive Incel-related videos; and (b) an Incel-related video at hop $M + 1$ assuming the user already watched M consecutive Incel-related videos for both the Incel-derived and Control recommendation graphs.

behavior of a user who chooses to watch a few Incel-related videos and investigate whether or not they will get recommended Incel-related videos with a higher probability within the next few hops.

Table 6 reports how likely it is for a user to encounter Incel-related videos assuming they have already watched a few. To do so, we use the random walks on the Incel and Control graphs and zero in on those where the user watches consecutive Incel-related videos. Specifically, we report two metrics: 1) the probability that a user encounters at least one Incel-related video in $5 - M$ hops, having already seen M consecutive Incel-related videos; and 2) the probability that the user will encounter an Incel-related video on the $M + 1$ hop, assuming they have already seen M consecutive Incel-related videos. These metrics allow us to understand whether the recommendation algorithm keeps recommending Incel-related videos to a user that starts watching a few of them.

At every hop M , there is a $\geq 43.4\%$ and $\geq 36.5\%$ chance to encounter at least one Incel-related video within $5 - M$ hops in the Incel-derived and Control recommendation graphs, respectively. Furthermore, by looking at the probability of encountering an Incel-related video at hop $M + 1$, having already watched M Incel-related videos (third and right-most column in Table 6), we find an increasingly higher chance as the number of consecutive Incel-related increases. Specifically, for the Incel-derived recommendation graph, the probability rises from 4.1% at the first hop to 30.1% for the last hop. For the Control recommendation graph, it rises from 2.1% to 17.7%.

These findings show that, as users watch Incel-related videos,

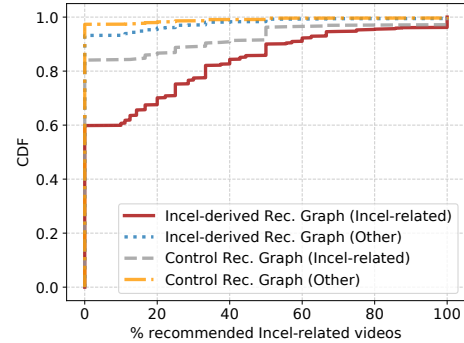


Figure 8: CDF of the percentage of recommended Incel-related videos per video for both Incel-related and other videos in the Incel-derived and Control recommendation graphs.

the algorithm recommends other Incel-related content with increasing frequency. In Figure 8, we plot the CDF of the percentage of Incel-related recommendations for each node in both recommendation graphs. In the Incel-derived recommendation graph, 4.6% of the Incel-related videos have more than 80% Incel-related recommendations, while 10% of the Incel-related videos have more than 50% Incel-related recommendations. The percentage of Other videos that have more than 50% Incel-related recommendations is negligible. Although the percentage of Incel-related recommendations is lower, we see similar trends for the Control recommendation graph: 8.6% of the Incel-related videos have more than 50% Incel-related recommendations.

Arguably, the effect we observe may be a contributor to the anecdotally reported filter bubble effect. This effect entails a viewer who begins to engage with this type of content and likely falls down an algorithmic rabbit hole, with recommendations becoming increasingly dominated by such harmful content, which also becomes increasingly extreme [49, 52, 56, 60, 63]. However, the degree to which the above-inferred algorithm characteristics contribute to a possible filter bubble effect depends on: 1) personalization factors; and 2) the ability to measure whether recommendations become increasingly extreme.

5.4 Take-Aways

Overall, our analysis of YouTube’s recommendation algorithm yields the following main findings:

1. We find a non-negligible amount of Incel-related videos (2.9%) within YouTube’s recommendation graph being recommended to users;
2. When a user watches a non Incel-related video, if they randomly follow one of the top ten recommended videos, there is a 2.8% chance they will end up with an Incel-related video;
3. By performing random walks on YouTube’s recommendation graph, we find that when starting from a random non Incel-related video, there is a 6.3% probability to encounter at least one Incel-related video within five hops.
4. As users choose to watch Incel-related videos, the algorithm recommends other Incel-related videos with increasing frequency.

6 Discussion

Our analysis points to an increase in Incel-related activity on YouTube over the past few years. More importantly, our recommendation graph analysis shows that Incel-related videos are recommended with increasing frequency to users who keep watching them. This indicates that recommendation algorithms, to an extent indeed, nudge users towards extreme content. This section discusses our results in more detail and how they align with existing research in the area. We also discuss the technical challenges we faced and how we addressed them, and highlight limitations.

6.1 Challenges

Our data collection and annotation efforts faced many challenges. First, there was no available dataset of YouTube videos related to the Incel community or any other Manosphere groups. Guided by other studies using Reddit as a source for collecting and analyzing YouTube videos [55], and based on evidence suggesting that Incels are particularly active on Reddit [20, 58], we build our dataset by collecting videos shared on Incel-related communities on Reddit. Second, devising a methodology for the annotation of the collected videos is not trivial. Due to the nature of the problem, we hypothesize that using a classifier on the video footage will not capture the various aspects of Incel-related activity on YouTube. This is

because the misogynistic views of Incels may force them to heavily comment on a seemingly benign video (e.g., a video featuring a group of women discussing gender issues) [19]. Hence, we devise a methodology to detect Incel-related videos based on a lexicon of Incel-related terms that considers both the video’s transcript and its comments.

We believe that the scientific community can use our text-based approach to study other misogynistic ideologies on the platform, which tend to have their particular glossary.

6.2 Limitations

Our video annotation methodology might flag some benign videos as Incel-related. This can be a false positive or due to Incels that heavily comment on (or even raid [41]) a benign video (e.g., a video featuring a group of women discussing gender issues). However, by considering the video’s transcript in our video annotation methodology, we can achieve an acceptable detection accuracy that uncovers a substantial proportion of Incel-related videos (see Section 3.2). Despite this limitation, we believe that our video annotation methodology allows us to capture and analyze various aspects of Incel-related activity on the platform. Another limitation of this approach is that we may miss some Incel-related videos. Notwithstanding such limitation, our approach approaches the lower bound of the Incel-related videos available in our dataset, allowing us to conclude that the implications of YouTube’s recommendation algorithm on disseminating misogynistic content are at least as profound as we observe.

Moreover, our work does not consider per-user personalization; the video recommendations we collect represent only some of the recommendation system’s facets. More precisely, we analyze YouTube recommendations generated based on content relevance and the user base’s engagement in aggregate. However, we believe that the recommendation graphs we obtain do allow us to understand how YouTube’s recommendation system is behaving *in our scenario*. Also, note that a similar methodology for auditing YouTube’s recommendation algorithm has been used in previous work [60].

6.3 RQ1: Evolution of Incel community on YouTube

As mentioned earlier, prior work suggests that Reddit’s decision to ban subreddits did not solve the problem [13], as users migrated to other platforms [51, 59]. At the same time, other studies show that Incels are particularly active on Reddit [21, 58], pinpointing the need to develop methodologies that identify and characterize Manosphere-related activities on YouTube and other social media platforms. Realizing the threat, Reddit took measures to tackle the problem by banning several subreddits associated with the Incel community and the Manosphere in general. Driven by that, we set out to study the evolution of the Incel community, over the last decade, on other platforms like YouTube.

Our results show that Incel-related activity on YouTube increased over the past few years, in particular, concerning the publication of Incel-related videos, as well as in comments that include pertinent terms. This indicates that Incels are increas-

ingly exploiting YouTube to spread their ideology and express their misogynistic views. Although we do not know whether these users are banned Reddit users that migrated to YouTube or whether this increase in Incel-related activity is associated with the increased interest in Incel-related communities on Reddit over the past few years, our findings are still worrisome. In addition, Reddit’s decision to ban /r/Incels for inciting violence against women [28] and the observed sharp increase in Incel-related activity on YouTube after this period aligns with the theoretical framework proposed by Chandrasekharan et al. [13].

Despite YouTube’s attempts to tackle hate [68], our results show that the threat is clear and present. Also, considering that Incel ideology is often associated with misogyny, alt-right ideology, and anti-feminist views, as well as with multiple mass murders and violent offenses [12, 69], we urge that YouTube develops effective content moderation strategies to tackle misogynistic content on the platform.

6.4 RQ2: Does YouTube’s recommendation algorithm steer users towards Incel communities?

Driven by the fact that members of the Incel community are prone to radicalization [11] and that YouTube has been repeatedly accused of contributing to user radicalization and promoting offensive content [37, 52], we set out to assess whether YouTube’s recommendation algorithm nudges users towards Incel communities. Using graph analysis, we analyze snapshots of YouTube’s recommendation graph, finding that there is a non-negligible amount of Incel-related content being suggested to users. Also, by simulating a user who casually browses YouTube, we see a high chance that a user will encounter at least one Incel-related video five hops after he starts from a non Incel-related video. Next, we simulate a user who, upon encountering an Incel-related video, becomes interested in this content and purposefully starts watching this type of videos. We do this to determine whether YouTube’s recommendation graph steers such users into regions where a substantial portion of the recommended videos are Incel-related. Once users enter such regions, they are *likely* to consider such content as increasingly legitimate as they experience social proof of these narratives. They may find it difficult to escape to more benign content [63]. Interestingly, we find that once a user follows Incel-related videos, the algorithm recommends other Incel-related videos to him with increasing frequency. Our results point to the filter bubble effect [56]. However, the filter bubble effect definition includes the notion that the extremist nature of the improper videos increases along with the frequency with which they are recommended. Since we do not assess whether the videos suggested in subsequent hops are becoming increasingly extreme, we cannot conclude that we find a statistically significant indication of this effect.

6.5 Design Implications

Prior work has shown apparent user migration to increasingly extreme subcommunities within the Manosphere on Reddit [58], and indications that YouTube recommendations serve as a pathway to radicalization. When taken along with our re-

sults, a more complete picture with respect to online extremist communities begins to emerge.

Radicalization and online extremism is clearly a *multi-platform* problem. Social media platforms like Reddit, designed to allow organic creation and discovery of subcommunities, play a role, and so do platforms with algorithmic content recommendation systems. The immediate implication is that while the radicalization process and the spread of extremist content generalize (at least to some extent) across different online extremist communities, the specific mechanism likely does not generalize across different platforms.

However, that does not mean that specific platform oriented-solutions should exist in a vacuum. For example, an approach that could benefit both platforms involves using Reddit activity to help tune the YouTube recommendation algorithm and using information from the recommendation algorithm to help Reddit perform content moderation. In such a hypothetical arrangement, Reddit, whose content moderation team is intimately familiar with the troublesome communities, could help YouTube understand how the content these communities consume fits within the recommendation graph. Similarly, Reddit’s moderation efforts could be bolstered with information from the YouTube recommendation graph. The discovery of emerging dangerous communities could be aided by understanding where the content posted by them fits within the YouTube recommendation graph compared to the content posted by known troublesome communities.

7 Conclusion

This paper presented a large-scale data-driven characterization of the Incel community on YouTube. We collected 6.5K YouTube videos shared by users in Incel-related communities within Reddit. We used them to understand how Incel ideology spreads on YouTube and study the evolution of the community. We found a non-negligible growth in Incel-related activity on YouTube over the past few years, both in terms of Incel-related videos published and comments likely posted by Incels. This result suggests that users gravitating around the Incel community are increasingly using YouTube to disseminate their views.

Overall, our study is a first step towards understanding the Incel community and other misogynistic ideologies on YouTube. We argue that it is crucial to protect potential radicalization “victims” by developing methods and tools to detect Incel-related videos and other misogynistic activities on YouTube. Our analysis shows growth in Incel-related activities on Reddit and highlights how the Incel community operates on multiple platforms and Web communities. This also prompts the need to perform more multi-platform studies to understand Manosphere communities further.

We also analyzed how YouTube’s recommendation algorithm behaves with respect to Incel-related videos. By performing random walks on YouTube’s recommendation graph, we estimated a 6.3% chance for a user who starts by watching non Incel-related videos to be recommended Incel-related ones within five recommendation hops. At the same time, users who have seen two or three Incel-related videos at the start

of their walk see recommendations that consist of 9.4% and 11.4% Incel-related videos, respectively. Moreover, the portion of Incel-related recommendations increases substantially as the user watches an increasing number of consecutive Incel-related videos.

Our results highlight the pressing need to further study and understand the role of YouTube’s recommendation algorithm in users’ radicalization and content consumption patterns. Ideally, a recommendation algorithm should avoid recommending potentially harmful or extreme videos. However, our analysis confirms prior work showing that this is not always the case on YouTube [60].

Future Work. We plan to extend our work by implementing crawlers that will allow us to simulate real users and perform random walks on YouTube with personalization. Note that this task is not straightforward as it requires understanding and replicating multiple meaningful characteristics of Incels’ behavior. We also plan to study other Manosphere communities on YouTube (e.g., Men Going Their Own Way) and user migration between Manosphere and other reactionary communities.

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