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The Dark Threads That Weave the Web of Shame: A Network Science-Inspired Analysis of Body Shaming on Reddit

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Abstract: Deep within online forums, we often stumble across body shaming. Words like “fat” and “ugly” are tossed around, hurting those they target. But can we peel back the layers of these online communities? In this study, social network analysis is used to shine a light on body shaming on Reddit, a well-known online platform. This paper presents a comprehensive social network analysis of body shaming on Reddit, one of the largest online platforms. The research delves into the intricacies of body shaming by identifying key actors, communities, and patterns of behavior and communication related to body shaming. The results show how behavior and communication differ across Reddit’s various subgroups, and how user activity and the length of comments can vary. Through the application of topic modeling, the main subjects discussed in each subgroup were identified. This enables an understanding of what drives discussions about body shaming. The findings provide valuable insights into the spread and normalization of harmful behaviors and attitudes related to body shaming, which can inform the development of targeted interventions aimed at reducing this harmful behavior and promoting more positive and inclusive attitudes towards body image and weight.

Keywords: body shaming; social network analysis; Reddit; online communities



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1. Introduction

In recent years, social media platforms have become increasingly popular and have radically changed the way we interact with one another. While social media platforms provide many benefits, including the ability to connect with others and share information, they can also be a breeding ground for harmful behaviors and attitudes [1–5]. One such behavior is body shaming, a form of social stigma that targets individuals based on their physical appearance. Body shaming can take many forms, including comments about weight, height, facial features, and skin color, among others. Body shaming can lead to negative health outcomes, self-esteem issues, and a range of mental health problems. Social media platforms, in particular, have been identified as a space where body shaming can thrive [6–8]. These platforms offer a level of anonymity and a lack of accountability that can fuel negative attitudes and behaviors. Among social media platforms, Reddit stands out as one of the largest and most diverse, with millions of users participating in thousands of subreddits, or online communities [9–11].

The goal of this paper is to unravel the dark threads that weave the web of shame on Reddit. The main research question is: “How do individual actors, group norms, and online communities interact to influence the spread and normalization of body shaming on Reddit?”. The objective is to use social network analysis to investigate the complex network dynamics that contribute to body shaming on Reddit. The contributions to the study of body shaming on social media platforms are threefold. First, no other past studies have employed social network analysis to provide a detailed understanding of how body shaming behaviors are propagated within and across subreddits. Second, key network features and central actors that are involved in the spread of body shaming

on Reddit are identified, providing insights into the social mechanisms that enable the persistence of harmful behaviors. Third, these analyses can inform the development of interventions aimed at reducing body shaming and promoting positive body image online. The experiments involved collecting publicly available data from Reddit and using social network analysis techniques to construct social networks related to body shaming. In the following, the analyses will identify subreddits where body shaming behaviors occur and extract information about users' interactions within these subreddits and other engagement metrics. Social network analysis techniques will be used to map the connections between users and identify patterns of interaction related to body shaming. The importance of this study lies in its ability to shed light on the complex and multifaceted nature of body shaming on social media platforms. By analyzing the social networks that facilitate the spread of body shaming on Reddit, it is possible to gain insights into how negative attitudes and behaviors are perpetuated and normalized. This study stands out as it takes a network science approach to analyze the structure and dynamics of interactions among users on Reddit, enabling the identification of key actors and communities within the network, which can be instrumental in shaping the discourse and norms around body shaming. Indeed, it can contribute to a better understanding of the social mechanisms that enable the persistence of harmful behaviors, and provide insights into how it is possible to work to unravel the webs of shame that threaten to ensnare us all. The findings of this study have significant practical implications, as they can inform the development of targeted interventions and policies on social media platforms to address body shaming, such as the implementation of stricter community guidelines, the moderation of harmful language, or the promotion of positive interactions.

The main contributions can be summarized as follows:

- A comprehensive social network that includes all comments made across various subreddits related to body shaming on Reddit is constructed and analyzed. This single network approach provides a holistic view of the body shaming dynamics on the platform.
- Key actors within the social network related to body shaming on Reddit are identified. This understanding can help to better comprehend the spread and normalization of harmful behaviors related to body shaming.
- Patterns of behavior and communication related to body shaming are analyzed, providing insights into the content and sentiment of discussions related to body shaming.
- Several ethical considerations and limitations of the approach are discussed, providing a comprehensive understanding of the challenges and potential solutions in studying body shaming on social media platforms. Importantly, this study contributes to improving the recognition of harmful behaviors in online social networks, which is crucial for developing effective interventions and policies.

In the following sections, relevant literature on social media, toxic behaviors online, and body shaming will be reviewed, the research methodology and analysis approach will be described. Then, results will be presented and discussed along with their implications for research and practice.

2. Literature Review

Social media platforms, such as Reddit, have become a crucial component of modern-day communication, providing individuals with the opportunity to connect with others from around the world. However, despite the many advantages of social media, the emergence of toxic and negative behaviors such as body shaming has become an alarming concern [12–17]. Toxic behaviors and their propagation have been investigated on general social media platforms. As an example, the spread of toxic content related to COVID-19 on social media platforms poses a significant challenge to the dissemination of important and time-sensitive information. To address this issue, the work in [18] presents techniques for analyzing toxic content and actors on YouTube during the initial months after COVID-19 information was made public. The authors applied topic modeling, social network

analysis, and toxicity analysis to identify dominant topics, evolving trends, influential commenters, and the overall health of the network. They also conducted experiments to simulate the impact of removing top toxic users on the network's overall toxicity level. The study's findings demonstrate how social media companies and policymakers can use these techniques to identify and mitigate toxic content related to COVID-19 on YouTube and other platforms. Overall, this work provides valuable insights into the nature of toxic content on social media platforms and highlights the need for continued research and interventions to promote more positive online interactions. The study presented in [19] takes a slightly different approach by focusing on the role of social media in political communication, with a focus on gender abuse and incivility. It provides valuable insights into the broader context of toxic behavior online.

The analysis of negative behaviors on Reddit is essential to understand how individuals interact with one another online and how these interactions can lead to negative outcomes on that online platform [20–24]. Several studies have explored different aspects of this issue. For instance, the study in [25] examined the role of Reddit in contributing to political polarization related to the COVID-19 pandemic. They found that news sources associated with highly toxic content were more likely to be shared across political subreddits, suggesting that social media platforms should promote neutral and scientific news sources to reduce toxic discussions. Instead, the authors of [26] analyzed the correlation between username toxicity and toxic behavior on Reddit. They found that users with toxic usernames tend to produce more toxic content and engage in more toxic behavior, indicating that username toxicity can predict toxic behavior and enhance online safety. The work presented in [27] is a case study on Reddit to understand the dynamics of toxicity in online discussions. They found that both author propensity and toxicity in a discussion context were strong positive antecedents of language toxicity. A similar work is the one presented in [28] where the authors combined toxic comment and toxicity trigger detection to identify the root causes of toxicity in discussion threads. Their findings provide valuable insights into the nature of toxicity on Reddit. In [29], the authors investigated the relationship between online toxicity and forum health in various online communities. They found that toxicity has a negative impact on community health, with larger communities being more susceptible to toxicity-related issues. An orthogonal study is presented in [30] where the authors analyzed the dilemma that online platforms face when applying interventions to toxic communities. They found evidence that Reddit's interventions for violating their content policy for toxic content occur because of media pressure. A data mining oriented approach is presented in [31] focusing on Not Safe for Work (NSFW) content. Here, the authors proposed a data mining approach for extracting and analyzing text patterns from NSFW adult content on Reddit. Their approach provides useful information about users publishing and accessing NSFW content and the language they adopt [32].

Although the analyses presented can be applied to different toxic behaviors, in this paper the focus is on body shaming. Body shaming is the act of criticizing or making negative comments about an individual's body shape, size, or appearance, and it has become an increasingly prevalent issue in online communities. Nevertheless, as will become clear, according to the current understanding such behavior has not been thoroughly investigated in the same terms as in this research. Building on the focus of body shaming in online communities, various studies have delved into this issue, albeit not in the same terms as in this paper. For instance, the study in [33] explores the impact of communication on Instagram on body image. This study provides a glimpse into how social media platforms like Instagram can influence teenagers' perceptions of their bodies, thereby contributing to the body shaming culture. Similarly, the authors of [34] discuss the impact of body shaming on mental health. It also highlights the role of social media celebrities in promoting thin bodies, which can exacerbate body shaming issues. This study underscores the need for a more comprehensive understanding of the psychological impact of body shaming in online communities. The research described in [35] provides a unique perspective by discussing how body-shaming of Black plus-size women can evoke change on Instagram. This study

is particularly relevant as it highlights the potential for social media platforms to be used as a tool for social change in the face of body shaming. Finally, ref. [36] discusses the mundane forms of social media communication, including the toxic activity and body shaming. This book provides a broader perspective on the issue, highlighting the pervasiveness of body shaming across various forms of social media communication.

Social network analysis, in particular, has emerged as a valuable methodology for analyzing online communities and identifying the patterns of behavior that contribute to toxicity. This paper presents an analysis framework to uncover the dynamics of body shaming on Reddit through a social network analysis approach. Different studies in the past used computer science approaches to study negative behaviors online, but none of them are primarily focused on body shaming, social network analysis, and Reddit. For example, the research in [37] discusses the challenges of managing undesirable behavior in online communities. The study found that communities often respond slowly to toxic users, highlighting the need for more effective monitoring and intervention strategies. In [38], the authors explore toxic behavior in online games, providing a large-scale, empirical understanding of toxic behavior. However, as per the existing knowledge, no past studies have analyzed a toxic behavior like body shaming in Reddit through social network analysis.

3. Methodology

Before studying the phenomenon of body shaming in Reddit, it is necessary to introduce the model of analysis. Specifically, Section 3.1 presents a formalization of the network used in the following analyses. Then, Section 3.2 describes the main social network-based metrics and approaches applied on the network model.

3.1. Network Model

This study utilizes a formal network modeling approach to conduct an in-depth social network analysis of body shaming on Reddit. The network is represented as a directed graph $G = \langle N, E \rangle$, where:

- N is the set of nodes, each representing a unique user who participated in one of the subreddits related to body shaming.
- E is the set of edges, each connecting a pair of nodes. An edge is drawn from one node to another if the corresponding user replied to or mentioned the other user in a comment. This creates a directed graph, reflecting the directionality of the communication between users.

In addition to the basic structure, a labeling function $L : N \rightarrow C$ can be introduced, where C is the set of communities within the network. For each node $n \in N$, $L(n)$ assigns the community of the user represented by the node.

This formal model captures the intricate dynamics of body shaming behavior on social media platforms in a structured and quantifiable manner. The resulting network model, complete with community assignments, provides a robust foundation for this social network analysis approach, offering valuable insights into the complex dynamics of this harmful behavior on social media platforms.

3.2. Measures of Network Centrality and Other Relevant Metrics

In this study, a combination of network centrality measures and community detection algorithms is employed to identify key actors and communities within the network. The network centrality measures used in this study is Degree Centrality (C_D), capable of identifying nodes with a large number of connections to other nodes, which may indicate users who are highly active in discussions related to body shaming. Formally, for a given node i , the degree centrality $C_D(i)$ is defined as the number of edges connected to node i . Users with high degree centrality are likely to significantly influence the flow of information and ideas within the network. In addition to this centrality measures, the Girvan–Newman algorithm for community detection [39] is able to identify clusters of nodes that are more strongly connected to one another than to nodes in other communities.

It works by iteratively removing edges with the highest betweenness centrality until the graph is divided into a set of disjoint communities. Betweenness Centrality (C_B) is a measure used to identify nodes that are important in the flow of information or influence within the network. Formally, for a given node i , the betweenness centrality $C_B(i)$ is defined as the sum of the fraction of all-pairs shortest paths that pass through node i . Users with high betweenness centrality may not necessarily have the highest degree centrality, but they play a crucial role in connecting different parts of the network and facilitating the spread of ideas. This enables the identification of groups of users who are particularly active in discussions related to body shaming. Finally, through sentiment analysis it was also possible to understand how users in different communities approach the themes of physical appearance and body.

By using a combination of these network centrality measures and community detection algorithms, it was possible to identify key actors and communities within the social network related to body shaming on Reddit. These insights can help inform interventions aimed at reducing body shaming and promoting positive body image on social media platforms. This methodology provides a comprehensive understanding of the ways in which users interact and the norms and values that underlie their behaviors, thereby offering a robust foundation for further research and intervention design.

4. Results

This section presents the results of the analysis on body shaming on Reddit, including network visualizations and analysis of network structure. The analysis sheds light on patterns of behavior and communication across subreddits or communities related to body shaming and provides insights into the role of social network dynamics in perpetuating harmful behaviors. Section 4.1 describes the steps for data collection and pre-processing. Section 4.2 presents the support network model specialized on the Reddit dataset used for the analyses. Section 4.3 shows the results of the analysis on key actors involved in body shaming. Section 4.4 discusses the different patterns in behaviors and communication of users in the analyzed dataset. Finally, Section 4.5 presents a comparison of the differences between the subreddits considered in the analyses.

4.1. Data Collection and Preprocessing Techniques

Publicly available data were collected from Reddit using the PRAW (Python Reddit API Wrapper) library during a one-year period from 12 April 2021 to 11 April 2022. However, due to recent changes in Reddit's Terms for Developer Tools and Services, which emphasize user content ownership and usage permissions, the dataset collected is not publicly available (<https://www.redditinc.com/blog/2023apiupdates>, accessed on 19 July 2023). In this paper, the data shown have been processed to remove personally identifiable information to respect user privacy and comply with Reddit's updated terms. However, the original, non-anonymized dataset can be requested for legitimate research purposes.

The selection of the four subreddits (r/fatpeoplestories, r/fatlogic, r/progresspics, and r/loseit) was based on a systematic and informed approach. Firstly, a keyword search was conducted for terms related to body shaming, such as "fat shaming", "skinny shaming", and "body image". This was performed to identify subreddits where discussions or instances of body shaming were likely to occur. While several subreddits were identified, only r/fatpeoplestories, r/fatlogic, r/progresspics, and r/loseit were used for the analyses. Other subreddits were more general, covering a broad range of topics, which could dilute the focus on body shaming. The chosen subreddits were rich in body shaming discussions, offering diverse perspectives from users with different experiences. They also had large, active user bases, which is crucial for social network analysis. Therefore, all other subreddits were discarded in favor of those most relevant and active in body shaming discussions. For each subreddit, all comments made over the one-year period were collected, along with associated user and subreddit information. To preprocess the data, duplicated comments were removed, along with any possible data that can cause self-loops in the network. All

comments that can lead to isolated nodes in the network with no connections to other nodes were also removed, i.e., all users who did not participate in any discussions related to body shaming. Finally, to ensure user anonymity and comply with Reddit's terms of service, anonymized usernames will be used in the following.

Once the data were collected, exploratory analyses were conducted to better understand the properties of the dataset. The summary statistics for each subreddit are presented in Table 1, showing the number of comments, unique authors, and average number of comments per author, for each subreddit.

As Table 1 shows, r/progresspics and r/loseit had the largest number of comments, with over half a million comments each over the one-year period. On the other hand, r/fatpeoplestories and r/fatlogic had lower numbers of comments, but still had thousands of comments each. Across all subreddits, there were a total of 1.35 million comments made by 53,656 unique authors. On average, authors contributed around 15 comments each. By conducting these exploratory analyses, it was possible to gain a better understanding of the size and characteristics of the dataset, which will inform all the subsequent analyses.

Table 1. Statistics of the considered subreddits.

Subreddit	Comments	Authors	Avg. Comments per Author
r/fatpeoplestories	47,238	4718	9.99
r/fatlogic	115,396	11,492	10.04
r/progresspics	607,948	37,054	16.41
r/loseit	580,932	25,392	22.89

4.2. Network Visualizations and Analysis of Network Structure

The network model described in Section 3.1 was implemented using the NetworkX package in Python 3, a robust tool for the creation, manipulation, and study of complex networks. Figure 1 shows a visualization of a small sample of the network. Each node of the network is a user who wrote a comment in one of the four subreddits considered. Two nodes are linked by an edge if one user has replied to the other user in a comment. Nodes are colored according to the corresponding user subreddit's membership. As shown in Figure 1, the overall network related to body shaming on Reddit is highly connected, with many nodes and edges. There are several distinct communities within the network, which are identified using different colors. Some communities are more densely connected than others, indicating that certain groups of users are particularly active in discussions related to body shaming.

The network structure was also analyzed using measures of network centrality, as described in Section 3. Table 2 shows the top 10 nodes in the overall network, ranked by their degree centrality. As shown in the table, the top 10 nodes in the overall network have a really high degree centrality, indicating that they are highly active in discussions related to body shaming. Their high activity levels suggest that they are key players in these discussions, likely initiating conversations, responding frequently, and interacting with a large number of other users. This level of engagement positions them as potential influencers within the network, as they have the capacity to significantly shape the flow of information and ideas. Their posts and comments could potentially reach a wide audience, thereby influencing the discourse and attitudes towards body shaming within these online communities. Their role, therefore, is crucial in understanding the dynamics of body shaming discussions on Reddit.

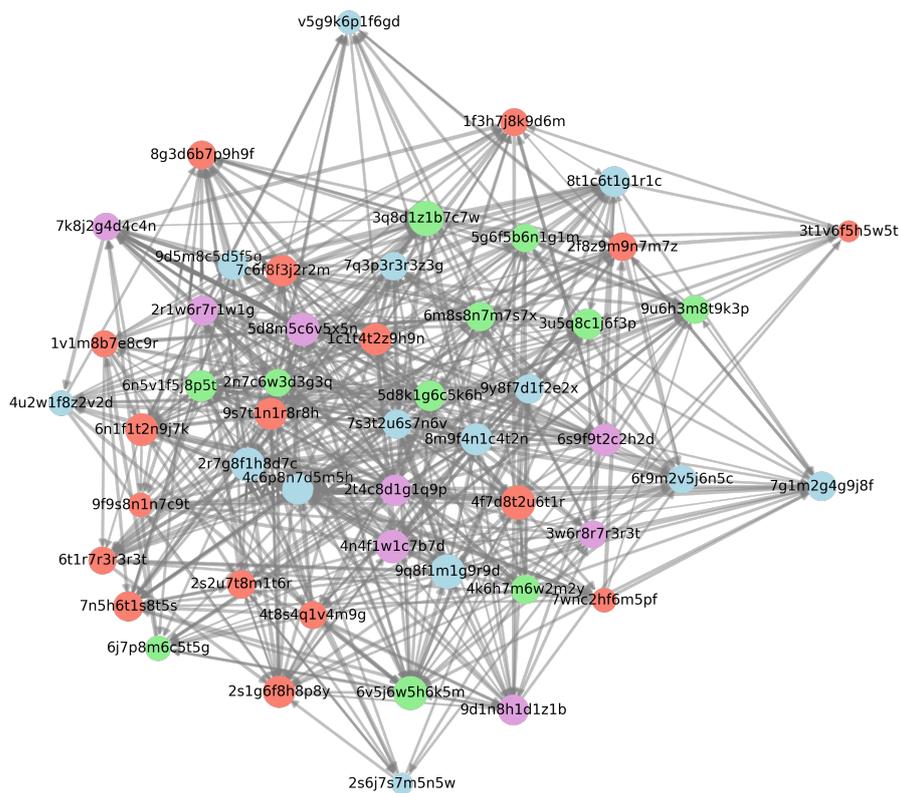


Figure 1. Visualization of the an example of the social network related to body shaming on Reddit.

Table 2. Top 10 nodes in the network, ranked by degree centrality.

Node	Degree Centrality
u/er5pnb9x	1134
u/tc6f8z7w	924
u/s7f5tz6d	842
u/f2x9sm7e	802
u/ry8wv6xa	736
u/fz6h9x8m	684
u/hd9tq6r3	678
u/jm2qz1ne	646
u/wk1nq7tx	616
u/tz8fj6vn	586

Another outstanding result was the identification of several distinct communities within the social network related to body shaming. For example, users in r/progresspics subreddit were more likely to engage in positive and supportive behaviors related to body image and weight loss, while users in the r/fatpeoplestories and r/fatlogic subreddits were more likely to engage in negative and shaming behaviors related to body size and weight. This finding underscores the diverse attitudes and behaviors related to body image across different Reddit communities, which can significantly impact the overall discourse on body shaming on the platform. Another outstanding result was the identification of several key actors, within the ones with the highest degree centrality, who were particularly active in discussions related to body shaming. These users were often moderators or frequent contributors to discussions on multiple posts related to body shaming. Their high level of activity and central position within the network suggest that they could potentially play a significant role in shaping the discourse and attitudes towards body shaming on

Reddit. Their influence underscores the importance of understanding the role of key actors in online discussions related to body shaming.

Overall, these analyses provide valuable insights into the complex dynamics of body shaming on social media platforms like Reddit. By identifying key actors and communities within the network, it is possible to better understand the spread and normalization of harmful behaviors and attitudes related to body shaming, and develop interventions aimed at reducing this harmful behavior.

4.3. Identification of Key Actors and Communities Involved in Body Shaming

The previous analysis of the social network related to body shaming on Reddit enabled the identification of key actors and communities within the network. Measures of network centrality were used to gain insights into the flow of information and influence within the network, as well as the norms and values that underlie users' behaviors related to body shaming. One outstanding result of the analysis was the identification of several highly active users who were key actors in the network. By understanding the behavior and attitudes of these key actors, it is possible to better understand the spread and normalization of harmful behaviors related to body shaming, and develop targeted interventions aimed at reducing this behavior.

To further explore the role of key actors in the network, the distribution of comments made by the top 10 users with the highest degree centrality in the overall network can be analyzed. Table 3 shows the percentage of total comments made by each of these users across all subreddits related to body shaming. As shown in the table, the top 10 users with the highest degree centrality accounted for a significant percentage of total comments made across all subreddits related to body shaming. The data suggest that these top 10 users, who account for a significant percentage of total comments, play a crucial role in shaping the discourse around body shaming across the analyzed subreddits. Their high level of activity and engagement positions them as influential figures within these communities. Their comments can set the tone for subsequent discussions and shape the overall attitudes towards body shaming. As active participants, they can also influence others' behavior, shaping the broader community culture. Therefore, understanding the role and influence of these key actors is crucial for developing strategies to address body shaming on Reddit. Their significant contribution to the discourse suggests that interventions targeting these influential users could have a substantial impact on the overall tone and content of discussions related to body shaming.

Table 3. Distribution of comments made by Top 10 users with highest degree centrality.

User	# of Comments	% of Total Comments
u/er5pnb9x	4381	6.8%
u/tc6f8z7w	3561	5.5%
u/s7f5tz6d	3284	5.1%
u/f2x9sm7e	3131	4.9%
u/ry8wv6xa	2876	4.5%
u/fz6h9x8m	2630	4.1%
u/hd9tq6r3	2616	4.1%
u/jm2qz1ne	2488	3.9%
u/wk1nq7tx	2371	3.7%
u/tz8fj6vn	2263	3.5%

In addition to identifying key actors, this analysis also enabled the identification of distinct communities within the social network related to body shaming. To further explore these communities, it was possible to study the distribution of comments made by users within each community. Table 4 shows the distribution of the sentiment of comments made by users in each of the five communities within the overall network. As shown in the table, there are distinct differences in the distribution of comments made by users in different communities within the social network related to body shaming. For example,

users in the r/progresspics subreddit were more likely to engage in positive and supportive behaviors related to body image and weight loss, while users in the r/fatpeoplestories and r/fatlogic subreddits were more likely to engage in negative and shaming behaviors related to body size and weight. Moreover, as shown below, additional analyses on topics revealed that some communities were more tightly-knit than others, indicating that certain groups of users were more likely to engage with each other and share similar attitudes and beliefs related to body shaming. With community detection algorithms it was possible to identify these tightly-knit communities, and found that they often centered around particular themes related to body shaming.

Table 4. Distribution of positive, negative, and neutral comments made by users in the subreddits within the network.

Community	Positive	Negative	Neutral
r/progresspics	43.2%	19.4%	37.4%
r/fatlogic	9.6%	77.3%	13.1%
r/fatpeoplestories	6.1%	88.3%	5.6%
r/loseit	28.4%	33.4%	38.2%
r/bodyacceptance	72.1%	5.7%	22.2%

By understanding the key actors and communities within the social network related to body shaming on Reddit, it is possible to better understand the spread and normalization of harmful behaviors and attitudes related to body shaming. This information can inform the development of targeted interventions aimed at reducing this harmful behavior and promoting more positive and inclusive attitudes towards body image and weight, especially in those communities polarized on toxic behaviors.

4.4. Analysis of Patterns of Behavior and Communication Related to Body Shaming

In addition to identifying key actors and communities within the social network related to body shaming on Reddit, patterns of behavior and communication related to body shaming were analyzed too. Specifically, the content of comments and the sentiment of language used in discussions related to body shaming were explored. To analyze the content of comments, natural language processing techniques were employed to identify the most common words and phrases used in discussions related to body shaming across all subreddits. Figure 2 shows a word cloud visualization of the most commonly used words in these discussions.

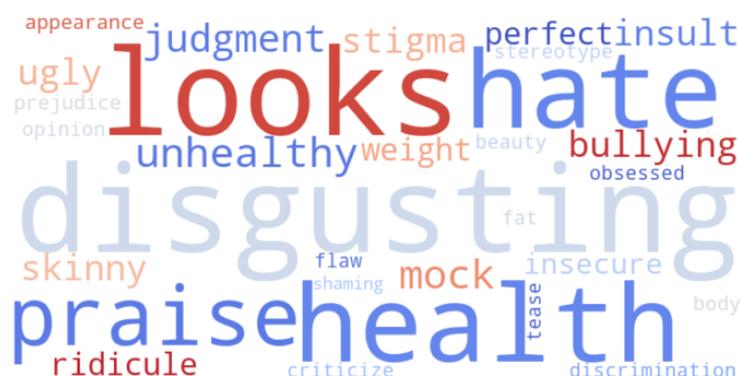


Figure 2. Word cloud visualization of most commonly used words in discussions related to body shaming on Reddit.

As depicted in Figure 2, the words “looks”, “praise”, “health”, and “hate” are prominently featured, indicating their frequent usage in discussions related to body shaming on

Reddit. The prominence of these words suggests that the discourse around body shaming on Reddit is heavily centered on physical appearance (“looks”), health perceptions (“health”), and emotional responses, both positive (“praise”) and negative (“hate”). The presence of “looks” and “health” as dominant words underscores the focus on physical attributes and health status in body shaming discussions. This could reflect societal pressures and stereotypes around body image and health. The word “praise” might be associated with discussions where users are supporting each other’s body positivity or weight loss journeys. However, it could also be used sarcastically or in a negative context, highlighting the complexity of language use in these discussions. On the other hand, the prominence of the word “hate” suggests the presence of strong negative emotions in these discussions. This could indicate a high level of animosity, prejudice, or discrimination in these online spaces, which can contribute to the perpetuation of body shaming behaviors.

The distribution of sentiment scores for comments made across all subreddits related to body shaming was further analyzed to explore the sentiment of language used in these discussions. Figure 3 shows a histogram of sentiment scores for all comments, with negative sentiment scores indicating negative language and positive sentiment scores indicating positive language. The sentiment analysis of discussions related to body shaming on Reddit, as indicated by the mean sentiment score around -0.25 , reveals a prevailing negative tone. This negativity is indicative of harmful behaviors and attitudes towards body image and weight that are prevalent in these discussions. The discourse often includes derogatory language, body shaming, and the propagation of harmful stereotypes, which contribute to a hostile environment for individuals of varying body types and sizes. This negativity not only reflects the attitudes of individuals participating in these discussions but also potentially influences the perceptions and behaviors of other users who read these comments. This underscores the importance of addressing body shaming on platforms like Reddit, as it can perpetuate harmful attitudes and behaviors, and negatively impact the mental health and well-being of users.

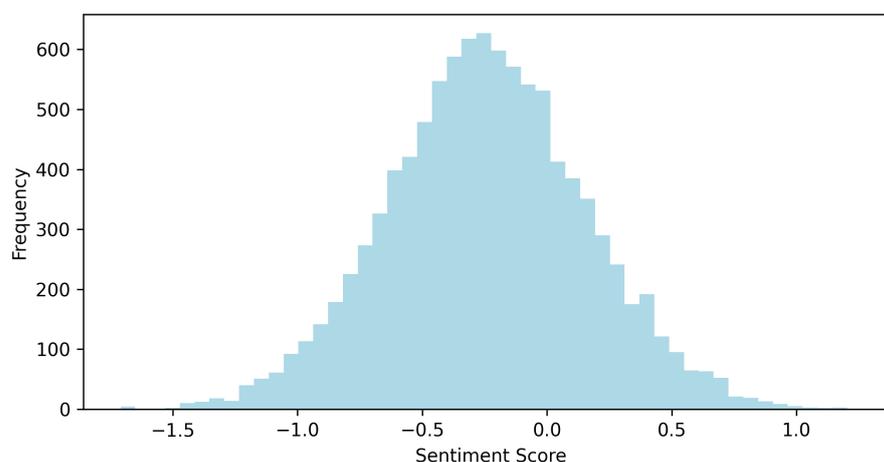


Figure 3. Histogram of sentiment scores of comments related to body shaming on Reddit.

Moreover, the sentiment of language used in comments varies significantly across different communities. Figure 4 shows a boxplot of sentiment scores of comments made by users in each of the five communities within the network. As shown in the figure, users in the *r/bodyacceptance* subreddit had significantly higher mean sentiment scores than users in other communities, indicating a more positive and supportive tone in discussions related to body image and weight. Conversely, users in the *r/fatlogic* and *r/fatpeoplestories* subreddits had significantly lower mean sentiment scores, indicating a more negative and shaming tone in discussions related to body shaming.

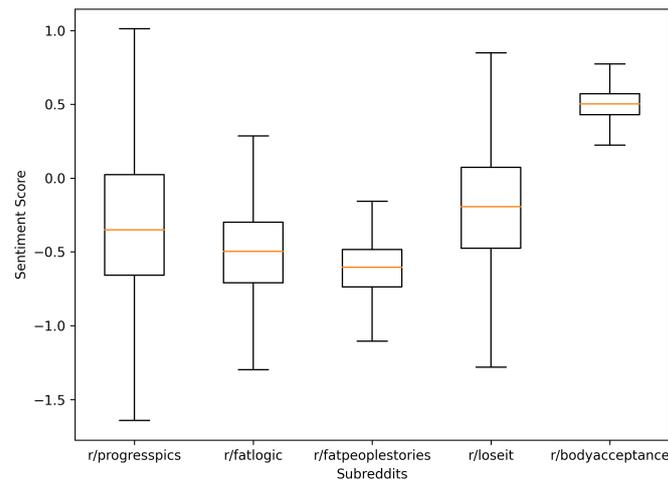


Figure 4. Boxplot of sentiment scores of comments made by users in subreddits within the network.

Overall, the analysis of patterns of behavior and communication related to body shaming on Reddit highlights the harmful attitudes and behaviors that can be perpetuated through online social networks. By identifying these patterns and understanding their underlying drivers, it is possible to develop targeted interventions aimed at reducing body shaming and promoting more positive and inclusive attitudes towards body image and weight.

4.5. Comparison of Findings Across Different Subreddits or Communities

To further understand the differences in patterns of behavior and communication across subreddits or communities related to body shaming on Reddit, some additional analyses were conducted beyond those presented in the previous sections. Figure 5 shows a scatter plot of user activity in each subreddit. This plot presents the distribution of the number of comments against the number of unique users. Each point in the plot is a group of users who made the same number of comments. For example, in the subreddit r/fatlogic there are around 1000 unique users who wrote near 8 comments each. That is a point in the scatter plot. For a better visualization, the outliers have been avoided, taking only users with an activity near average values. As shown in the figure, there is considerable variation in user activity across subreddits or communities related to body shaming on Reddit. For example, r/progresspics has the highest number of unique users who made comments, while r/fatpeoplestories has the fewest. Additionally, there is a wide range in the number of comments made by individual users.

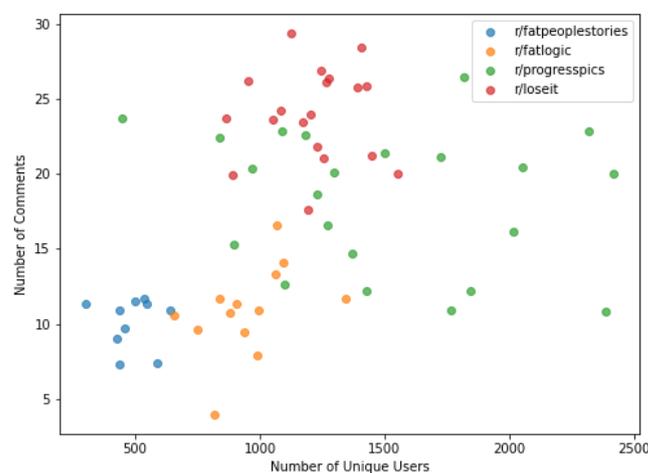


Figure 5. Scatter plot of user activity in different subreddits of the network.

An additional plot made is the distribution of comment length in each subreddit to examine the differences on how much users write across subreddits related to body shaming. Figure 6 shows the histograms of comment length in each subreddit. As shown in the figure, comments in r/fatlogic and r/fatpeoplestories tend to be shorter, with a peak at around 50 words. Comments in r/progresspics and r/loseit tend to be longer, with a peak at around 100 and 115 words, respectively.

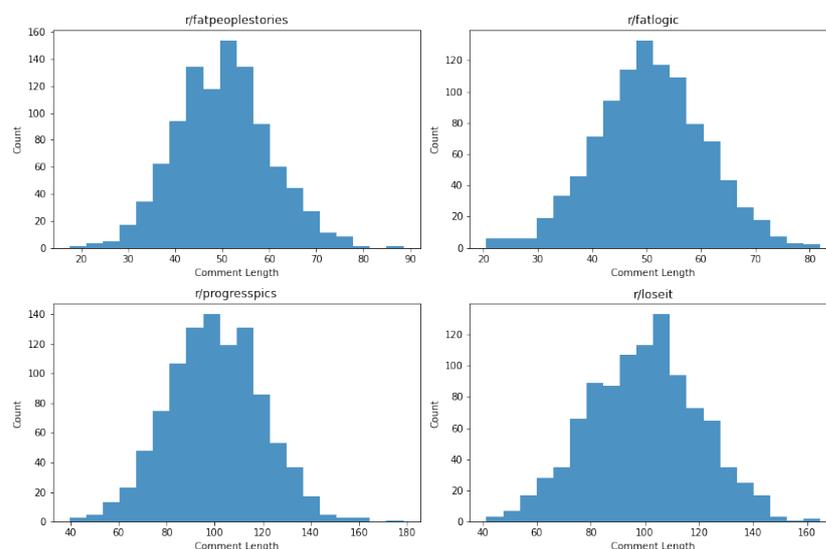


Figure 6. Histograms of comment length in different subreddits of the network.

To identify the most common topics discussed in each subreddit related to body shaming on Reddit, a topic modeling using Latent Dirichlet Allocation (LDA) was conducted on a sample of comments from each subreddit. Table 5 shows the top five topics identified in each subreddit, along with the most representative words for each topic. As shown in Table 5, there are differences in the most common topics discussed in each subreddit. For example, r/fatpeoplestories and r/fatlogic tend to focus more on physical appearance and lifestyle critique, while r/progresspics and r/loseit focus more on weight loss progress and exercise/fitness.

Table 5. Top five topics and representative words in different subreddits of the network.

Subreddit	Top Five Topics and Representative Words
r/fatpeoplestories	Body Shaming Stories (fat, story, people) Physical Appearance Critique (ugly, hair, face) Lifestyle Critique (lazy, job, kids) Health Critique (diabetes, heart, diet) Body Positivity (self, love, confidence)
r/fatlogic	Weight Loss Advice (calories, diet, exercise) Fat Acceptance (body, fat, positive) Physical Appearance Critique (ugly, hair, face) Lifestyle Critique (lazy, job, kids) Health Critique (diabetes, heart, diet)
r/progresspics	Weight Loss Progress (progress, weight, month) Exercise and Fitness (gym, workout, run) Body Transformation (transformation, difference, face) Diet and Nutrition (meal, food, eat) Mental Health (anxiety, depression, therapy)
r/loseit	Weight Loss Progress (progress, weight, month) Diet and Nutrition (calorie, eat, food) Exercise and Fitness (gym, workout, run) Mental Health (anxiety, depression, therapy) Body Positivity (self, love, confidence)

5. Discussion

5.1. Discussion on Research Findings

This study provides insights into the patterns of behavior and communication across different subreddits related to body shaming on Reddit. The findings suggest that there are significant differences in the distribution of sentiment, user activity, comment length, and topics discussed in each subreddit. These differences have important implications for understanding the dynamics of body shaming on social media platforms and for developing interventions to address this harmful behavior.

One of the key findings of this study is that sentiment varies across subreddits related to body shaming. The sentiment analysis revealed that comments in *r/progresspics* tend to be more positive, while comments in *r/fatpeoplestories* tend to be more negative. Another important finding is that there is considerable variation in user activity across subreddits or communities related to body shaming on Reddit. The subreddit *r/progresspics* had the highest number of unique users who made comments, while *r/fatpeoplestories* had the fewest. Additionally, there is a wide range in the number of comments made by individual users, with some users making hundreds or thousands of comments, while others make only a few. These findings suggest that there are different levels of engagement and participation in different subreddits related to body shaming on Reddit. They offer important insights for enhancing the image of social media platforms. The positive sentiment in *r/progresspics* indicates a supportive environment, which can serve as a model for other subreddits. By promoting such positive discussions, platforms can foster a more inclusive and respectful community. Conversely, the negative sentiment and lower user activity in *r/fatpeoplestories* highlight areas for improvement. Platforms can address this by closely monitoring such subreddits and taking action against body shaming behaviors, thus ensuring a safer online environment.

Furthermore, the study found that comments in *r/fatlogic* and *r/fatpeoplestories* tend to be shorter, while comments in *r/progresspics* and *r/loseit* tend to be longer. This suggests that different subreddits have different norms around commenting behavior, with some subreddits encouraging shorter comments and others encouraging longer, more detailed comments. The topic modeling analysis revealed that the most common topics discussed in each subreddit related to body shaming on Reddit were different. For example, *r/fatpeoplestories* and *r/fatlogic* tend to focus more on physical appearance and lifestyle critique, while *r/progresspics* and *r/loseit* focus more on weight loss progress and exercise/fitness. These differences in topics reflect the different goals and interests of users in each subreddit and highlight the need for tailored interventions to address body shaming on social media platforms. This study provides new insights into the ways in which social network dynamics may contribute to these behaviors, including variations in sentiment, user activity, comment length, and topics discussed. These findings can inform the development of interventions to address body shaming on social media platforms, such as targeted messaging campaigns or community guidelines that encourage positive interactions and discourage harmful behaviors. They can significantly contribute to improving the image of social media platforms. The observed differences in comment lengths across subreddits suggest that platforms can tailor their content moderation strategies to the specific norms of each community. For instance, shorter comments in *r/fatlogic* and *r/fatpeoplestories* may require more stringent moderation due to their potential for quick, negative remarks. On the other hand, longer comments in *r/progresspics* and *r/loseit*, which often revolve around personal progress and fitness advice, may benefit from a different moderation approach that encourages supportive and constructive feedback. The topic modeling analysis also provides valuable insights for platforms to develop tailored interventions. By understanding the common topics discussed in each subreddit, platforms can design targeted messaging campaigns or community guidelines that resonate with the specific interests and goals of each community. For instance, campaigns in *r/progresspics* and *r/loseit* could emphasize the importance of supportive feedback on weight loss progress, while those in *r/fatpeoplestories* and *r/fatlogic* could focus on promoting respectful discussions about

physical appearance and lifestyle. Moreover, the new insights provided by this study into the social network dynamics of body shaming behaviors can inform the development of more effective interventions. By understanding the variations in sentiment, user activity, comment length, and topics discussed, platforms can design interventions that address the specific dynamics contributing to body shaming in each community. This could include, for example, the development of community guidelines that encourage positive interactions and discourage harmful behaviors.

In conclusion, this study provides insights into the patterns of behavior and communication across different subreddits or communities related to body shaming on Reddit. The findings suggest that there are significant differences in the distribution of sentiment, user activity, comment length, and topics discussed in each subreddit. These findings have important implications for understanding the dynamics of body shaming on social media platforms and for developing interventions to address this harmful behavior.

5.2. Comparison with Past Research

This research has made several advancements in the understanding of body shaming on Reddit. Unlike previous studies that have primarily focused on the content of discussions [15,25,27,37], this research has taken a network science approach to analyze the structure and dynamics of interactions among users. This enabled the identification of key actors and communities within the network, which can be instrumental in shaping the discourse and norms around body shaming. In terms of sentiment analysis, while previous studies have examined the overall sentiment of discussions [11,32], this research goes a step further by analyzing the distribution of sentiment across different subreddits, revealing significant differences in the tone of discussions, and providing a nuanced understanding that can inform the development of more targeted interventions to address body shaming. This has revealed significant differences in the tone of discussions, with some subreddits having a more positive sentiment and others having a more negative sentiment. This nuanced understanding of sentiment can inform the development of more targeted interventions to address body shaming.

This study has also made advancements in understanding user activity. While previous research has examined the overall level of user activity [31,32,38], the distribution of user activity across different subreddits and among individual users have been analyzed. This has revealed a wide range of engagement levels, with some users being highly active and others being less active. Understanding these variations in user activity can help in identifying users who may be more susceptible to engaging in or being affected by body shaming. Furthermore, this research has expanded the understanding of the topics discussed in relation to body shaming. While previous studies have identified common themes in discussions [18,22,24], the distribution of topics across different subreddits has been analyzed here. This has revealed that different subreddits focus on different aspects of body shaming, reflecting the diverse interests and concerns of users.

In conclusion, this study has made significant advancements in understanding the dynamics of body shaming on Reddit. By taking a network science approach, it was possible to uncover the complex interplay of interactions, sentiment, user activity, and topics that shape the discourse around body shaming. These findings not only contribute to the existing body of literature but also provide valuable insights for developing more effective interventions to address body shaming on social media platforms.

5.3. Ethical Considerations and Limitations of the Approach

When conducting research on online communities, there are several ethical considerations to take into account. One of the main concerns is protecting the privacy and anonymity of users who participate in these communities. To address this concern, all personally identifiable information has been removed, including usernames and subreddit names, from the data. At the time of download, only publicly available data have been collected, in accordance with previous Reddit's terms of service. However, it is important

to recognize that the often unregulated nature of online communities can make it difficult to fully protect user privacy and anonymity. It is possible that some users may have engaged in harmful behaviors that were not fully captured or fully understood, which may have implications for the generalizability of the results.

An attempt was made to capture a broad range of subreddits related to body shaming, yet it is acknowledged that the sample might not fully represent all discussions related to this topic on Reddit. Additionally, data from only a one-year period were analyzed, which may not fully encapsulate the long-term dynamics of the social network related to body shaming on Reddit. While the analysis can identify key actors and communities within the network, it does not provide insights into the motivations or attitudes that underlie users' behaviors. There is a possibility that some users engage in body shaming behaviors without fully understanding the harm they may cause, or without intending to cause harm. Future research could explore these underlying attitudes and motivations using qualitative methods, such as interviews or surveys. In addition, this study focused on a specific set of subreddits related to body shaming, and it is possible that different patterns would emerge in other subreddits or on other social media platforms. Additionally, the analysis focused on comments and did not examine other types of user-generated content, such as posts or images. Finally, this study did not explore the experiences and perspectives of individuals who have been targeted by body shaming on social media platforms.

Despite these limitations, the approach employed in this study provides a valuable tool for understanding the complex dynamics of body shaming on social media platforms. Key actors and communities within the social network related to body shaming on Reddit were identified through the use of social network analysis, which can inform interventions aimed at reducing this harmful behavior. Furthermore, the approach can be applied to other online communities, providing a means to better understand the spread and normalization of harmful behaviors and attitudes on social media platforms.

6. Conclusions

In this study, the patterns of behavior and communication related to body shaming across four subreddits or communities on Reddit were investigated. The findings demonstrate that differences exist in user activity, sentiment, comment length, and topics discussed across these subreddits or communities. The subreddit *r/progresspics* was found to have the highest number of unique users and longer comments compared to other subreddits, while *r/fatpeoplestories* had the fewest users and shorter comments. The most common topics discussed in each subreddit also differed, with *r/fatpeoplestories* and *r/fatlogic* focusing more on physical appearance and lifestyle critique, while *r/progresspics* and *r/loseit* focused more on weight loss progress and exercise/fitness.

The significance of these findings is not only in the insight they provide into the dynamics of harmful behaviors, such as body shaming, on social media platforms. More importantly, they lay a foundation for future research and interventions. The methods and findings of this study can be instrumental in shaping future works, particularly those employing machine learning techniques for automatic detection and flagging of "body shaming" in comments. This could significantly aid in moderating these platforms and improving their overall image. Moreover, the development and testing of interventions to address body shaming on these platforms could be pursued. These interventions could include the use of positive reinforcement or moderation of harmful language. The integration of machine learning could also be beneficial in this regard, as it could help in the identification of harmful behaviors and the implementation of automated responses or actions.

By continuing to investigate and address harmful behaviors on social media, and by leveraging advanced technologies such as machine learning, a safer and more inclusive online community for all can be worked towards. This study serves as a stepping stone towards that goal, and it is hoped that future research will continue to build upon these

findings, leveraging the methods and insights provided here to further the understanding of harmful behaviors on social media and develop effective interventions.

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