# Choose Your Own Avengers: A Network Analysis of the Marvel Comics Universe

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## Literature Review

Superhero comics existed in some form since the late 1930s, with Superman appearing in DC Comics’ *Action Comics #1*. Widely regarded as the archetype for customed superheroes that followed[[1]](#footnote-1), Superman spawned a love of customed heroes in our popular culture. While DC comics enjoyed dominance of the superhero genre, DC’s chief competitor entered the market in 1939, introducing the world to Marvel superheroes such as Captain America (introduced 1941), the X-Men (1963), and the Fantastic Four (1961).[[2]](#footnote-2)

Throughout the years, Superhero comics have played a malleable role in American popular culture. Some story arcs sought to portray struggles in American life, often reflecting the social issues of the time they were published. Comics can often be very thought-provoking, such as the popular graphic novel Watchmen by Alan Moore, portrays the decline of American cities in the later half of the 20th century, comments on geopolitics and nuclear warfare.[[3]](#footnote-3) Other times, their messages are merely entertainment, spawning campy supervillains such as the Condiment King[[4]](#footnote-4) who wields various ketchup and mustard-based weaponry and condiment-based puns with malice.

With nearly a hundred-year history to draw from, superheroes represent a unique opportunity to study from a network analysis perspective. Often heroes form teams, such as the Avengers or New Mutant, and fight together against some common enemy. Some characters exist within the same universe, but often cross-over events occur, with some characters making appearances in storylines that they otherwise would not be a part of. Looking at the Marvel Comics Universe (MCU) from a network analysis perspective can show us which characters are most involved in the comics universe and how they interact with others within the comics universe.

## Research Problem:

With comics, movies, tv shows, and video games spanning over more than 50 years of publishing, it can be difficult to answer simple questions about the immense universe of Marvel storylines. To help better understand how different heroes interact with each other, I plan to investigate the following research questions:

1. Which superhero has the most connections?
2. Which superhero has the closest connections?
3. How efficiently can one major superhero connect to another major super hero?
4. How well do Women and People of color fair in the network compared to white superheroes?
5. Are there any superheroes that may play an outsized role in the network?

## Details of Dataset

Data for this analysis was originally constructed by Cesc Rosselló, Ricardo Alberich, and Joe Miro from the University of the Balearic Islands.[[5]](#footnote-5) The underlying data come from the [Marvel Chronology Project,](https://www.chronologyproject.com/) an volunteer-run website dedicated to cataloging every actual appearance by every significant character in the Marvel Universe and place them in their proper chronological order. The Chronology Project uses strict criteria to document character appearances. Dreams and photos/portraits of characters are not considered appearances. If a flashback occurs, every character who appears in the flashback is listed, and the project attempts to place this flashback in its proper chronological place. If the story contains a revelation to a previous story (e.g. the current story reveals that the villain was behind the scenes in a previous story), this is considered an appearance.[[6]](#footnote-6)

The dataset contains two types of connections, hero connections and comic connections. For the purpose of this analysis, we will focus solely on the hero connections. The dataset contains 6,,439 unique hero nodes with 424270 connections in the network. For clarity, self-connections (e.g. a hero meeting a past version of themselves) and duplicate connections were removed. After removing duplicate connections, 183,633 unique connections remained. After trimming isolate nodes and subnetworks, a total of 5,603 distinct heroes remained in the dataset.

## Applied Social Network Analysis Methods

With such a large network, it became immediately necessary to trim the size of the network to be more manageable. Isolate connections represented about two percent of the total network. After removing isolated connections, visual inspection showed that the network map had several isolated sub-networks in the data, often with fewer than five connections. To trim these subnetworks, any node with five or fewer connections were dropped from the dataset. Three sub networks with greater than 5 connections were also removed from the dataset.

Once isolate and subnetworks were removed, I used closeness centrality to determine the proportion of connections in the network connected to each hero. Immediately this revealed many minor characters with closeness centrality metrics between 10% to 100%. For reference, Captain America (a hero that has existed since 1948) had a closeness of 0.00008808245. This led me to conclude that there were additional small subnetworks that were still present in the data. Thus, any heroes with a closeness of 10% or greater were removed.

After recalculating the closeness centrality, I examined the overall degree centrality of the network. The average degree centrality of the network was 64 connections with a median of 26 connections. The network generally followed the power-law distribution, with the vast majority of the connections having under 20 connections (see Figure 1). Lastly, I calculated the eigenvector centrality of the network to determine which heroes had the strongest influence over the network.

## Results

To little surprise, Captain America was the top hero across all three centrality metrics (see Table 1). This is not terribly surprising given that Captain America has existed far longer than most of the other super heroes in the Marvel Universe. He had over 700 more connections than the second ranked hero (The Thing from the Fantastic Four). He is top ranked for closeness with and has a perfect eigenvector value of one. Given his vast connections, Captain America has enormous importance in the network. He is directly connected to 47% of the overall network. Given the sheer volume of his connections, he can connect more efficiently than any other superhero in the network overall.

Even though comics are fictional, they still reflect the biases of their creators. This is evidenced by the fact that despite being a member of the Fantastic Four, Mrs. Fantastic was not ranked highly in the network as her male counterparts. Following Captain America, the male members of the Fantastic Four come in second, third, and fourth place respectively. The Thing, Mr. Fantastic, and the Human Torch all had very close centrality to each other. Degree centrality for these members ranged from 1830 to 1905, and the heroes’ closeness metrics were nearly identical. Women and heroes of color generally were not highly ranked across any of the centrality metrics. Storm from X-Men broke the top ten at rank 9, being both the only female hero and person of color to make the top 10.

One non-superpowered human ranked surprisingly high in the marvel comics network. J. Jonah Jameson, the foul-mouthed newspaper editor from the Spiderman comics was ranked 22nd overall in the network. He had over 1,170 connections and a surprisingly high closeness value. In fact, he had a higher closeness value than Quicksilver (X-Men), who had a higher degree centrality than him. Despite his high ranking, he had a low eigenvector value. This is likely due to his proximity to Spiderman and thus is only likely to appear in comics with Peter Parker-driven storylines.

## Discussion:

This study provides insights into the interconnectedness of superheroes in the Marvel Comics Universe. While the highly successful Marvel Movies from Disney have enshrined many of these names into our regular lexicon, many of the top ranked heroes were from series that are not as visible in popular culture today as the movies. Both the Fantastic Four and the X-Men had a strong showing across the centrality metrics overall, reflecting stronger popularity in the comics universe relative to the recent movies or television shows. This study also reflected the biases that exist within the comic book industry. Nearly all top-ranked superheroes were Caucasian, reflecting the further need for diverse characters in literature.

Further analyses could incorporate additional stratification of the dataset by heroes, villains, and anti-heroes. One potential area of further research is seeing which hero/villain partnerships occur most often, or if there are any anti-heroes that are central to the main comics universe. Additionally, while this analysis solely focused on the inter-hero connections, further analysis could examine the comic ties between the actors to determine if the rankings would reflect similar results. Further research could explore the centrality of superheroes in other comic book universes and the impact of diversity and representation on network centrality.

## Appendix:

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| --- | --- | --- | --- | --- |
| **Table 1: Centrality Measures** | | | | |
| Hero | **Degree Centrality** | **Closeness Centrality** | **Eigenvector Value** | **Rank** |
| **CAPTAIN AMERICA** | 2688 | 0.00010136 | 1.00000000 | 1 |
| THING/BENJAMIN J. GR | 1905 | 0.00009653 | 0.84317400 | 2 |
| MR. FANTASTIC/REED R | 1851 | 0.00009630 | 0.82104740 | 3 |
| HUMAN TORCH/JOHNNY S | 1830 | 0.00009626 | 0.82240990 | 4 |
| THOR/DR. DONALD BLAK | 1799 | 0.00009573 | 0.79737940 | 5 |
| BEAST/HENRY &HANK& P | 1737 | 0.00009559 | 0.81662650 | 6 |
| HAWK | 1608 | 0.00009422 | 0.73778590 | 7 |
| CYCLOPS/SCOTT SUMMER | 1521 | 0.00009436 | 0.76758510 | 8 |
| STORM/ORORO MUNROE S | 1489 | 0.00009349 | 0.74642200 | 9 |
| ANGEL/WARREN KENNETH | 1466 | 0.00009282 | 0.73954240 | 10 |
| SHE-HULK/JENNIFER WA | 1435 | 0.00009314 | 0.76119010 | 11 |
| COLOSSUS II/PETER RA | 1430 | 0.00009354 | 0.74293160 | 12 |
| HULK/DR. ROBERT BRUC | 1426 | 0.00009441 | 0.72996890 | 13 |
| ANT-MAN/DR. HENRY J. | 1413 | 0.00009212 | 0.69527080 | 14 |
| WONDER MAN/SIMON WIL | 1371 | 0.00009190 | 0.72277060 | 15 |
| MARVEL GIRL/JEAN GRE | 1355 | 0.00009252 | 0.65922420 | 16 |
| SUB-MARINER/NAMOR MA | 1338 | 0.00009312 | 0.66834970 | 17 |
| HERCULES [GREEK GOD] | 1322 | 0.00009171 | 0.71524810 | 18 |
| DAREDEVIL/MATT MURDO | 1287 | 0.00009234 | 0.63168540 | 19 |
| NIGHTCRAWLER/KURT WA | 1185 | 0.00009141 | 0.59705980 | 20 |
| QUICKSILVER/PIETRO M | 1181 | 0.00009078 | 0.67257980 | 21 |
| JAMESON, J. JONAH | 1176 | 0.00009106 | 0.47101490 | 22 |
| ROGUE / | 1145 | 0.00009060 | 0.63027490 | 23 |
| QUASAR III/WENDELL V | 993 | 0.00008934 | 0.60464570 | 24 |
| NOVA/RICHARD RIDER | 949 | 0.00008903 | 0.52880670 | 25 |
| CRYSTAL [INHUMAN] | 948 | 0.00008883 | 0.56714050 | 26 |
| PSYLOCKE/ELISABETH B | 945 | 0.00008894 | 0.54701600 | 27 |
| BLACK PANTHER/T'CHAL | 912 | 0.00008902 | 0.53981090 | 28 |
| SILVER SURFER/NORRIN | 880 | 0.00008789 | 0.53604270 | 29 |
| CANNONBALL II/SAM GU | 866 | 0.00008781 | 0.43993560 | 30 |

Chart, histogram

Description automatically generated

Figure 2: Network Map of the Marvel Comics Universe

Diagram

Description automatically generated with medium confidence

Works Cited:

"Superhero." Britannica. Accessed March 17, 2023. <https://www.britannica.com/art/superhero>.

"Marvel Comics." Britannica. Accessed March 17, 2023. <https://www.britannica.com/topic/Marvel-Comics>.

"The politics and people that inspired Watchmen." Polygon, October 15, 2019. Accessed March 17, 2023. <https://www.polygon.com/comics/2019/10/15/20909951/watchmen-comic-alan-moore-politics-characters-explained>.

"Condiment King." Batman Wiki. Accessed March 17, 2023. <https://batman.fandom.com/wiki/Condiment_King#History>.

Alberich, R., J. Miro-Julia, and F. Rossello. “Marvel Universe Looks Almost like a Real Social Network.” arXiv.org, February 11, 2002. <https://arxiv.org/abs/cond-mat/0202174>.

Chronology FAQ - Frequently Asked Questions - The Chronology Project Website: <https://www.chronologyproject.com/faq.php#Q16> Accessed: March 17, 2023.

1. "Superhero." Britannica. Accessed March 17, 2023. <https://www.britannica.com/art/superhero>. [↑](#footnote-ref-1)
2. "Marvel Comics." Britannica. Accessed March 17, 2023. <https://www.britannica.com/topic/Marvel-Comics>. [↑](#footnote-ref-2)
3. "The politics and people that inspired Watchmen." Polygon, October 15, 2019. Accessed March 17, 2023. <https://www.polygon.com/comics/2019/10/15/20909951/watchmen-comic-alan-moore-politics-characters-explained>. [↑](#footnote-ref-3)
4. "Condiment King." Batman Wiki. Accessed March 17, 2023. <https://batman.fandom.com/wiki/Condiment_King#History>. [↑](#footnote-ref-4)
5. Alberich, R., J. Miro-Julia, and F. Rossello. “Marvel Universe Looks Almost like a Real Social Network.” arXiv.org, February 11, 2002. https://arxiv.org/abs/cond-mat/0202174. [↑](#footnote-ref-5)
6. Chronology FAQ - Frequently Asked Questions - The Chronology Project Website: <https://www.chronologyproject.com/faq.php#Q16> Accessed: March 17, 2023 [↑](#footnote-ref-6)