Fear Not, True Believers: Exploring Network Structures Among Characters in the Marvel Comic Universe

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Comics as a Research Paradigm or "Journey into Mystery"

Comic books are an oft-discounted literary tool, passed by as simplistic reading for children (Ndalianis). However, recent years have seen a marked increase in the awareness of comics and their super-powered *dramatis personae*. Even as the print comic industry financially struggles and seeks to reinvent itself (Salkowitz; Elbein), the return of characters both popular (e.g., Superman, Spiderman, Joker) and obscure (e.g., Emma Frost, Deadpool, Ra's al Ghul) to cinemas and television screens has been linked to an increase in issue sales of their print counterparts (Lucas; Cox and Steinberg). One reason for comics' resolute cultural import is they afford a rich look at how authors and artists interpret contemporary structures, often reflecting cultural values and our understanding of society (Facciani, Warren and Vendemia). For example, comics – particularly Marvel comics – were early bastions of depictions of inclusion and acceptance of non-majority or stigmatized peoples (Muszynsky), dealing with issues including racism (Taylor), sexual orientation (Taylor; Bendis), and gender identity (Pollack), both allegorically and explicitly. Particularly as young readers often use behaviors and frameworks depicted in comics to model and interpret social order (Xu, Perkins and Zunich), the societal influence of comic books should not be readily dismissed.

[1] This work was conducted under the advisement and with the support of Dr. Cliff Lampe (D.C. Comics fan) as part of TC462c at Michigan State University.

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Of particular interest to the present work is the manifestations of characters' affiliations and organizations: how superheroes' and supervillains' groups are formed, maintained, and spanned by individual members. This interest is particularly germane as comics increasingly reflect collaborations among characters. Comics have long emphasized collaborations among characters (Baker); but the last decade has seen the formula for mainstreaming superheroes change, as popular films and comic storylines have focused less on a maverick main character in favor of crossovers and team efforts. Even multi-title crossovers have become common, as publishers attempt to boost sales via interesting and storyline-spanning groupings (Elbein). Perhaps nothing exemplifies comics' emphasis on collaboration and organizational structures than the 2019 release of the *Avengers: Endgame* movie, featuring a team-up of previously-solo superheroes including Iron Man, Black Widow, Thor, Captain America; as well as 32 other heroes from across the various franchises comprising the Marvel Cinematic Universe. Yet interest in comic team-ups should be more than commercially-driven, as collaborations among heroes (and villains) has been a staple – and often focal point – of comic books (Jozwiak). And though much has been said about comics and their cultural impacts, the networks among comic characters remains undertheorized and explored. Given this, the present work seeks to go beyond understanding how in-comic networks drive sales or marketing, and instead seeks to reveal what makes certain superheroes (and supervillains) so prone to collaboration. Approaching this issue by applying social network theory and analysis can reveal and help theorize some of the structural and individual properties of superhero networks in ways that have not been previously well-detailed. Such an exploration is useful to understand how characters in comics are used and relate; but also presents a means of applying and testing theories of networks that may be challenging in real world organizations.

Organizational Collaboration and Structures or "To Me, My X-Men"

Collaboration among individuals allows groups to accomplish goals that may not be met individually (Wittenbaum, Vaughan and Strasser). Organizations benefit from the coordinated actions of their members pursuing mutual goals, benefiting from collective (rather than individualistic) efforts of their members (Marwell and Oliver). Early paradigms exploring collaboration focused on how members within an organization maximized productivity and production (Weber). Later traditions

such as relational perspectives (Rogers and Kincaid) and network analysis (Monge and Contractor; Wasserman and Faust) have focused instead on the dynamic structures that are created and emerge as individuals interact, both internally and externally of the organization, creating links within and beyond their organizations.

Interorganizational linkages – the individuals who connect two or more organizations – allow an organization to more readily transfer resources, including financial, physical, and social capital (Burt; Williamson), as well as increase exchange alternatives through increased network links (Pfeffer and Salanick). Individuals connecting organizations and enabling resource transference are said to fill linking roles and serve as structural mechanisms in interorganizational relationships. The complex roles and relations of linking individuals has been the subject of much academic interest, particularly when exploring the social structure of networks and their interactions and interactions.

Network Ties in Organizations or "Bodyslide by Two." Granovetter discussed two types of linking roles an individual may fill in any social structure: either strong or weak ties. Strong ties are the individuals with whom one frequently interacts, like coworkers. Contrarily, weak ties are individuals more likely to link one to new and unexpected opportunities and ideas, like a colleague at a competing firm. These ties have often been addressed with respect to Putnam's idea of social capital, in that these ties are often used to facilitate the exchange of resources and information within a network. Specifically, strong ties often manifest as bonding capital – dense networks effective at, "undergirding specific reciprocity and mobilizing solidarity" (Putnam 22). Weak ties often manifest as bridging capital – broader networks that facilitate membership with multiple social groups and reciprocity. Putnam noted bridging ties are better for linking external assets and information diffusion.

A particularly germane field of research has focused on the effect of board interlock, the process by which an executive of one organization sits on the board of directors of another organization (Mizruchi). Interlocks serve as interorganizational bridging ties, important for the transfer of information and resources, including facilitating the transfer of physical capital or resources under conditions of economic or environmental crisis (Doerfel et al.) or situational complexity (Keats and Hitt). Interlocks can also help diffuse an idea through network interlinks, such as the intentional dissemination of a 'poison pill' (i.e., negative information about a firm under threat of being purchased by a hostile buyer) to artificially inflate a firm's acquisition cost beyond the financial resources of the hostile buyer (Davis).

Recent scholarship has considered the personal and network characteristics of board interlocks, and weak ties more broadly. Shropshire proffered that network members demonstrating greater organizational tenure, centrality, and breadth of experience should positively influence an organization's diffusion of practices; while network members demonstrating greater conformity and homogeneous behaviors should decrease the organizational diffusion of practices. While theoretically guided and demonstrating high face validity, testing the relative effects of characteristics identified by Shropshire may be methodologically problematic. Given the difficulty of gathering data about all members across multiple organizations, one significant methodological challenge to testing such propositions is the need to census each board interlock member's networks to fully assess relative influences between and within each network.

As Wasserman and Faust noted, bounding a network can be a difficult task, with one requisite of a comprehensive analysis of the interplay of actors in a network being a census of individuals. This challenge is evident in many social network analyses, which are unable to fully map networks due to time and budgetary limitations as well as lack of subject participation. For example, Frank and Yasumoto's network analysis of interactions within the elite French banking system was conducted with a sample of only twenty-eight bankers. Similarly, Carr and Zube's study of in- and out-of-game interactions of members of a *World of Warcraft* guild was constrained to a single guild, and the researchers noted their findings may not generalize to other guilds in *World of Warcraft* or other online multiplayer games. As these two studies exemplify, prior studies of boundary spanners in real world networks have been limited by challenges in obtaining a network census. Comics offer a means of overcoming these limitations by enabling a complete census of network members, and concurrently applying theoretically-guided principles to empirically explore and understand the complex networks occurring in comics.

Network Ties in Comics or "Avengers Assemble." Teamwork and collaborations among comic characters is, "a process of conflict and compromise for the greater good of either the superhero team or society at large" (Jozwiak 326). And yet the processes and paths of these affiliations remain largely unexplored. Some preliminary work has sought to merely map ego networks in comics (Davletov) or focus only on a subset of comic characters (e.g., heroes; Shi, Yu and Ren). However, as detailed and complete analyses of networked interactions can reveal undiscovered or hidden patterns of interactions and implications for how

audiences may assimilate content depicted in mass media (Tan, Ujum and Ratnavelu), exploring the associations across an entire comic universe using network theory can reveal and help understand the myriad affiliations in which comic characters engage.

Perhaps because of how often comic characters are faced with both internal conflict and world-, universe-, or reality-ending threats (Isaak), comic characters often affiliate with multiple groups, sometimes even altering alignments (e.g., from "good" to "evil" and/or back). For example, in his 47-year publication history, Wolverine has been a member of 15 groups including the X-Men, Alpha Flight, the Avengers, and Apocalypse's Horsemen. Wolverine's proclivity to join and leave teams is so great that Spencer recently depicted Wolverine as errantly forgetting he had been affiliated with a particular group (see Figure 1). A character like Wolverine, who has been affiliated with multiple groups, may be considered to possess a high outdegree: the number of links between the actor and other actors (Brass). Outdegree has been shown to correlate with an individual's indegree (Mislove et al.), which refers to the "number of nodes that are adjacent to [an actor]" (Wasserman and Faust 126). In the present work, outdegree represents the number of organizations with whom a character is associated, and indegree represents the number of other characters with whom that character is connected through their mutual membership with an organization. As such, outdegree conceptually reflects the individual's ability to access resources within a network through network ties (Martinez et al.).

Figure 1. Wolverine has been on so many teams, he has forgotten some of them. From Spencer's *Giant Size Amazing Spider-Man #1*

Recalling Shropshire's characteristics predicting positive outcomes from bridging ties, outdegree should be positively correlated with centrality: how central a character is within a network. Among other measures of centrality (e.g., betweenness centrality, degree centrality), this work specifically considers closeness centrality, or how accessible and connected an individual is to all other members of the network (Wasserman and Faust). A character with great closeness centrality in the Marvel Universe would require fewer steps to access any given other member of the Universe, and thus that character should be able to more readily influence the network. Further, outdegree should be closely related to an individual's breadth of experience (Shropshire), as individuals with greater experience are expected to possess more diverse networks, and therefore greater outdegrees. Though demonstrating high face validity, it important to validate Shropshire's assertions through hypothesis testing. These assertions can be hypothesized in comics, just as they could in real world organizations. Thus, it is predicted:

H1: A character's outdegree is positively correlated with the character's closeness centrality.

H2: A character's outdegree is positively correlated with the character's network experience.

Though previous studies have attempted to identify the characteristics of network actors that predict the actors' outdegrees, including narcissism and emotiveness (e.g., Clifton, Turkheimer and Oltmanns), such studies have been hindered by methodological limitations on the network structure, particularly the inability to take a census of an organization's internal and external stakeholders. Consequently, an initial area of inquiry for this research is to inductively evaluate other characteristics of actors with high outdegrees beyond the two a priori hypotheses, guiding the study's research question:

RQ: What characteristics are shared by characters in the Marvel universe with high outdegrees of connectedness?

Method or "Excelsior!"

Data Collection or "Flame On!" To understand how comic characters interact, it is first needed to know the entire cast of characters and whom interacts with whom. Marvel Comics was selected as a population from which to draw, due to its large character base, long publication history, and frequent crossover of characters. As

Marvel Comics utilizes a multiverse (alternate realities), characters were drawn from Earth-616, "The primary continuity in which most Marvel titles take place" (Wikipedia), to minimize and account for continuity issues across its titles.[2] Examination of the characters and their affiliations in Marvel's Earth-616 universe therefore presents a large, yet bounded, dataset from which to draw.

Data were obtained via the fan-authored and Marvel-monitored Marvel Comic Database[3] (MCD). The MCD comprehensively catalogs characters in the Marvel Universe, including its comic, television, and cinematic properties. An automated Python program was designed and used to fetch, parse, and structure information from the MCD. This program scoured the Character pages of all individuals listed in the MCD, obtaining selected information for each character, including the character's name, group affiliation(s), alignment, first appearance, and Universe (as Marvel's comics span transfinite realities across the multiverse). The initial scrape of the MCD Character pages provided information for 10,568 individuals. However, as this research focused on individuals' associations within and among groups, only characters with at least one identified affiliation were used in analysis. Thus, the resulting data set[4] is comprised of 3,697 characters in the "Earth-616" universe.

Data Preparation or "It's Clobberin' Time." After completing the data collection, data were structured so that each character was matched with the specific organization(s) with which they were affiliated. Next, the NodeXL program (Smith et al.) was then used to construct a network graph of connections, with groups as the nodes of connection. In addition to creating a graphic representation of the network map of affiliations in the Marvel Universe[3], the NodeXL program also calculated social network analysis metrics for each character (including the character's closeness centrality and outdegree), which were then imported into SPSS (v. 19.0.0) for additional analysis and hypothesis testing.

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[2] Although a handful of characters (e.g., Dark Beast, X-Man Nate Grey, Sugar Man) have moved between Marvel universes, limiting analysis to a single continuity helps reflect a more natural structure of interaction, focusing as well on more sustained character development and processes than may occur in the television or film versions of characters.

[3] http://marvel.wikia.co

[4] Supplemental material, including data and network graph of Marvel characters, are available (and blinded) at: https://osf.io/7k9ep/?view_only=d820920f87884c3b918a635a1eaad855

Measures or "To Me, My Board." Closeness centrality, or how centrally located the character is within the holistic Marvel Universe, reflects the range of an actor's influence.[5] A character's outdegree was operationalized as the number of group with which that character had been affiliated, and can be considered as a measure of the breadth of connections made by a character (Wasserman and Faust).

A character's network experience was operationalized as the time an actor had been active in the network (Doreian), herein as the months since the character's first publication appearance. The character's first appearance was also scraped from the MCD and calculated as the number of months between first publication and the month of data collection. Characters' network experience ranged from 1 month to 864 months[6], reflecting Marvel's 72-year publication history (beginning as Timely Publications) to when data were collected.

Analyses or "With Great Power Comes Great Responsibility"

The first hypothesis predicts a positive correlation between a character's outdegree and closeness centrality. Linear regression analysis was conducted with a character's outdegree serving as the dependent variable and the character's closeness as the independent variable, and was significant.[7] A character's closeness was significantly, but negatively, associated with the character's outdegree.[8] Counter to the direction predicted by H1, a one-unit increase in a character's centrality typically correspond with a 0.15-unit decrease of the character's outdegree. In other words, as characters were more central to the Marvel Comic network they were typically a member of fewer organizations.

The second hypothesis predicts a positive correlation between a character's outdegree and network experience. Marvel introduced a huge number of characters in the early 1960s (later dubbed the "Marvel Age" due to the numerous and popular characters created, particularly between 1961 and 1964; Jozwiak; DeFalco; Baker), which was reflected in the distribution characters' experience. Because characters'

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[5] Specifically, closeness centrality refers to those network actors (*j*) who are reachable from the actor (*i*) in a finite number of steps (Wasserman and Faust).

[6] ($M = 436.08$, $SD = 415.70$)

[7] $F(1, 3695) = 86.78$, $p < .001$, adjusted $R^2 = .02$

[8] $\beta = -.15$

experience was not normally distributed,[9] attempting to fit a linear regression line to the data may not reflect the best fit. Therefore, data were fit to a quadratic model, predicting a character's outdegree from network experience. The quadratic model better-fit the data than the linear model,[10] and demonstrated a significant positive correlation between network experience and outdegree,[11] so that for every one month in which a character has been active in the Marvel Universe corresponds with a small but significant .05-unit increase of the character's outdegree. In other words, Marvel comic characters become affiliated (on average) with about one additional organization for every two years of their publication history, supporting H2.

The research question asked what characteristics are shared by characters with high outdegrees. Outdegree coefficients for characters in this sample ranged from one to seventeen,[12] and 90% of characters were affiliated with three or fewer groups. Ordering characters by descending outdegree allowed identification of the characters with highest outdegree. Table 1 presents the Marvel comic characters the highest outdegrees, displaying the 49 characters affiliated with at least nine organizations.

While it is enticing to attempt to categorize characters with high outdegrees based on superpowers, such categorization may not be particularly useful or generalizable: A team of like-powered heroes or villains makes for bad storytelling and stymies opportunities to capitalize on the holism enabled by organizational collaboration. Instead, to answer the research question, commonalities based on personal traits, interpersonal characteristics, and the nature of groups with which that character affiliates were considered as a more meaningful way to respond to the research question. That said, it is notable many of the characters identified in Table 1 lack some of the most common superpowers, like speed or flight. Rather, characters with high degrees of connection were often prolific combatants, either as melee fighters (e.g., hand-to-hand fighting, swordsmanship; including

[9] $D(.37) = .18$, $p < .001$

[10] $F(2, 3694) = 29.26$, $p < .001$, $R^2 = .02$, $\Delta R^2 = .01$

[11] $\beta = .002$, $p < .001$

[12] This distribution was both positively skewed (skewness = 3.38, *se* = .04) and leptokurtic (kurtosis = 14.71, *se* = .08).

Swordsman, Wolverine, Psylocke, and Black Knight) or as ranged combatants (e.g., marksmanship; including Black Widow, Viper, and Hawkeye).

Character	Outdegree	Character	Outdegree
Black Widow	17	Multiple Man	10
King Namor	16	Mystique	10
Swordsman	16	White Queen	10
Viper	15	Executioner	9
Psylocke	15	Golden Girl	9
Wolverine	15	Sentry	9
Human Torch	14	Loki	9
Banshee	13	Archangel	9
Razorfist	13	Professor X	9
U.S. Agent	13	Juggernaut	9
Beast	12	Havok	9
Hawkeye	12	Sunfire	9
Constrictor	12	Red Wolf	9
Black Knight	11	Mockingbird	9
Crimson Dynamo	11	Blackwing	9
Iron Fist	11	Storm	9
Ms. Marvel	11	Nova	9
Taskmaster	11	Eel	9
Sunspot	11	War Machine	9
Skids	11	Magma	9
Grim Reaper	11	Cannonball	9
Cable	11	Mirage	9
Thing	10	Wolfsbane	9
Enchantress	10	Boom-Boom	9
Atlas	10		

Table 1. Marvel comic characters with highest outdegree coefficients (representing largest number of group affiliations)

Discussion or “Imperious Rex”

What makes for a good superpowered collaborator? As team ups become more popular in comics, television shows, movies, and other media, there remains a need to understand which characters are effective collaborators and why. Responding to this need, the present research employed social network analysis to assess

organizational networks occurring within the Marvel comic universe. This network analysis revealed which individuals serve as bridging ties by spanning multiple groups, and help reveal how comic characters collaborate. Counter to H1, characters less central within the Marvel Universe are connected to more groups; but characters tend to affiliate with more groups over time, consistent with H2. Implications of findings, as well as some of the traits shared by the most-connected characters, are discussed below.

Traits Of Structural Bridges or "Welcome to The Team, Hope You Survive the Experience." What makes a character a likely group-spanning team member in the comics? The most affiliatory characters – those associating with the greatest number of groups over their publication history – were revealed to typically be loners, considered "good," and have a moderate publication history. These findings are detailed below, as well as their implications for our understanding of comics and beyond.

Bridges Are Loners or "Leave Hulk Alone." Of immediate note is the paradoxical finding that many characters with highest outdegrees (i.e., affiliated with the largest number of groups) are typically considered misanthropic characters, often preferring to work alone.[13] Most of the highest-connected characters actually prefer to operate in isolation, working solo and not making strong, permanent ties with individuals and groups. At first look, this desire to isolate or work alone is at tension with spanning of multiple groups. However, functional and structural explanations may both account for the paradox of loners as bridges.

A functional explanation of this paradox is that characters who possess unique skill sets are required for specific missions, leading the characters to briefly associate with a group to accomplish a particular goal or fix an internal process within the organization, only to disaffiliate upon completing that task to return to individualistic work. Loners would thus be highly-connected across multiple organizations, but only for short terms or as *ad hoc* members, as groups were in temporary need of their unique skills. Characters such as King Namor (ruler of the kingdom of Atlantis) and Beast (a renown bio-geneticist) can bring unique individual characteristics to bear to address specific situations (e.g., mobilizing Atlantis' military, curing a genetic disease), and then leave the group.

[13] There are notable exceptions of sociable individuals in Table 1, including two of the Fantastic Four (Human Torch and the Thing) and several X-Men (e.g., Banshee, Beast, Professor X).

A structural explanation of the paradox of loners as bridges is that amiable characters may be ensconced in their established groups, and thus less likely to interact with outside networks. For example, as a founding member of the Fantastic Four, Reed Richards (aka "Mr. Fantastic") has been closely and tightly associated with that team since its inception. Though he has occasionally lent his expertise and membership to other organizations (e.g., the Illuminati, Defenders), Reed Richards typically returns to the Fantastic Four. As a literal and figurative father figure to the Fantastic Four, Mr. Fantastic is a central and tightly-connected member within the Fantastic Four network with few connections to other organizations. Such a hypothesis is born out in the data, as characters' centrality closeness were negatively associated with their outdegrees.[14] Individuals more tightly connected intraorganizationally were less likely to be connected interorganizationally, so that once established and ingrained within a particular organization – even one central to the broader Marvel universe – they are less likely to leave that organization and seek out new group memberships.

For both explanatory paths, that misanthropes make for better bridging ties provides insight and parallels into the patterns of both real and fictitious networks. Loner comic characters may use their fewer close interpersonal ties to more effectively traverse broader organizational networks and access the resources of other groups, just as outcasts in organizations tend to span broader and more heterophilous networks (Kleinbaum; Kalish and Robins). Thus, counterintuitively, less-sociable characters may make for the best team-ups, helping introduce new skills, resources, and perspectives into a group. The trend in many cultural artifacts from movies to comics toward less traditional protagonists reflects this relationship. As misanthropes (e.g., Moon Knight, Joker) and antiheros (e.g., Deadpool, Harley Quinn) increasingly find themselves starring in solo titles, movies, and television shows, this may be in part because their more antisocial tendencies help prevent having a persistent cast of supporting characters, thereby inviting more frequent use of new characters. In other words, by not having to focus on the Fantastic Four each week/movie/issue, writers and consumers alike can continuously find new stories, situations, and (critically) collaborations to narratively explore. An additional implication here is that by presenting bridging characters not as the most central to the network, but rather than those with the most to offer various groups, comics may continue to be voices for the underrepresented (Bryan). Depicting Superman

[14] $r(3697) = -.15$, $p < .001$

as a team player is easy, in part because Superman conforms to so many societal norms and ideals. Presenting less-conforming characters like Loki and Boom Boom as individuals that may thrive by virtue of their ability to cross boundaries and align with numerous groups (rather than a single group membership), comics may create for readers a view of a world in which diverse and nonnormative individuals may be embraced and valued precisely because of their ability to interface with and benefit multiple affiliations.

Finding that loners are intensive collaborators also helps understand real world interactions within organizations. For example, a *turnaround specialist* refers to upper-level managers (particularly CEOs) briefly hired to underperforming organizations due to the individual's particular ability to positively affect organizational change and restore organizational performance and profitability (Fredenberger and Hoy). Turnaround specialists often do not remain in the organization after it resumes its normal performance level, leaving the organization for another failing business and allowing the former organization to hire on a full-time manager to replace the turnaround specialists (Boyd). As such, in organizations – just as in super-teams – individuals are sometimes needed for isolated brief collaborations to capitalize on their unique skill sets, after which they are again free agents, able to seek their next membership. Likewise, managers are highly-central within their own organization, and thus are less likely to be connected to outside organizations (Sozen, Basim and Hazir). This situates managers as bonding (rather than bridging) ties because of their ability to transfer resources internally rather than bring in new information or skills. From this work, organizations can learn from comics the value of bridging ties as means of effective resource transfer both into and out of the organization. Employees who may not be strongly connected within an organization's network may actually be very connected to other organizations within the industry, and thus be able to bring in new information or resources; and managers would do well to consider that some of the more valuable (from a network perspective) comic characters are those that may not be the most deeply integrated into a single organization.

Bridges Are Good or "Let Us Make Good." Characters who were more connected were also more likely align with "good" supergroups. Thirty of the 49 most-affiliatory characters are heroes, whereas only 12 were villains (the remaining 8 were neutrally-aligned). A *post hoc* ANOVA revealed alignment-based

differences in outdegree across all Marvel characters were statistically significant.[15] One reason for this disparate distribution is that "good" supergroups typically engage their communities in addition to saving the world, and thus provide opportunities for extra-organizational interaction. Contrarily, "evil" groups of supervillains often pursue more myopic goals such as bank robbing or world domination, which may not provide similar opportunities for networking. Comics (as well as other media) may thus seek opportunities to tell stories of team-ups that may feature more interactions among members beyond of their formal organizational duties. Even less-fantastic stories where characters – both good and evil – help rebuild buildings or come together to support a community (e.g., Straczynski) can be engaging tales and opportunities for both character exploration and for otherwise unconnected characters to collaborate and make connections.

The proclivity of heroes to ally more than villains may also be that comic books tend to focus on heroes over their foes. While a few antagonists and antiheros have had their own (often short-lived) titles (e.g., Joker, Magneto, Venom), comics tend to focus on good heroes. Writers' desire (or demand) tell the stories of good – rather than evil – characters may simply provide more opportunities for champions to affiliate more, relegating evil team ups (e.g., Brotherhood of Evil Mutants, Sinister Six, Legion of Doom) to second-class storylines threaded through the tales of super hero team ups. Stories focused on heroes simply provide more opportunities for those heroes to interact and affiliate.

Bridges Have Been Around for A Moderate Amount of Time or "Try Not to Die." Finally, well-connected comic characters have typically had longer publication histories, providing them time to affiliate with more groups. As evidenced in the testing of H2, there exists a positive ∩-shaped relationship between tenure and outdegree. In other words, the characters with the highest number of affiliations are not those with the longest or shortest time active in the Marvel-616 universe, but rather those in the middle of the distribution. Some of this may be due to the "Marvel Age" of comics introducing many now-classic characters in a short time span. A five-year period in the early-1960s saw the introduction of the *Fantastic Four, X-Men, Spider-Man, Thor, Hulk,* and dozens other heroes and villains who remain Marvel's best-known characters to-date (Baker). Many Silver Age characters remain popular, and thus exert a disproportionate pull on network connections. Older (i.e., Golden Age) characters

[15] $F(2, 3694) = 9.79$, $p < .001$, $\eta^2 = .01$. This small effect is likely due to the large sample size.

such as Ka-Zar and the android Human Torch have seen little use after being supplanted by Silver Age characters, and newer characters have not had time to join multiple organizations. This effect of a character's tenure on collaboration opportunities may be something to consider moving forward. Naturally, writers want to introduce collaborations among characters that are time-tested and audience-vetted, and collaborations among newer characters may not engage audiences not broadly familiar with the whole of a publisher's catalog. However, perhaps as online tools and fan-campaigns can quicken the process of a character's recognition, we may see characters with a shorter publication history be quickly embraced by audiences and the fandom and more immediately written into collaborative circumstances with multiple groups. The surprising popularity of Squirrel Girl (Ditko and Murray) may indicate an interesting character can be quickly identified by fans and readily incorporated into other supergroups.

Beyond the artifact of publication history, this curvilinear relationship may reflect some of the structural processes occurring in organizations more generally. Individuals initially joining an organization typically have few interorganizational network ties, as new members are typically focused on creating initial ties with intraorganizational ties. Alternately, those members who have been with an organization for a long time may see a decline in their interorganizational networks, as their tenure is typically associated with higher centrality within their own network (Liu, Ge and Peng). However, individuals with moderate organizational tenure, such as middle managers, typically engage in the most boundary-spanning activities, serving as both intraorganizational and interorganizational bridges (Pappas and Wooldridge). Consistent with these real-world findings, time within Marvel comics lets individual characters affiliate with more groups, though characters' group memberships seem generally stable after about 40 years.

Understanding Networks Or "My Spider Sense Is Tingling." A secondary contribution of this work to the field is methodological, helping evidence new means of testing theory and evaluating social network analyses in both intraorganizational and interorganizational collaborations. Interactions in popular media often reflect properties of real world networks (Tan, Ujum and Ratnavelu; Alberich, Miro-Julia and Rosselló), and can thus help overcome limitations in testing social network processes and influences in hard-to-access censuses of actual organizations (Wasserman and Faust). Using automated data collection techniques to obtain complete network affiliations and associations (often available on publicly-available social media as well as on proprietary enterprise social media;

Leonardi, Huysman and Steinfield), this study employs a novel means to collect data and test theory across broad, interconnected networks. For example, findings empirically supported several of Shropshire's propositions regarding the personal characteristics of board interlocks, including individuals with greater network experience have greater outdegree coefficients. Empirically demonstrating experience working within and across organizations often leads to increased ties relationship supports earlier theorizing that time in an industry will naturally lead to greater opportunities to encounter other network members, thereby increasing an individual's ability to span groups (Shropshire; Frank, Zhao and Borman). As scholars increasingly turn toward tools like server scraping and user logs to obtain data (Williams), tools for automating identifying complex network structures reflect emergent means of not only collecting data often unobtainable via surveys or interviews, but also reflect means of acquiring large sample populations from which social network analysts can obtain precise data about the associations and behaviors within complete networks.

Conclusion Or 'Nuff said

A popular culture text often discounted by society (and even academics), comics can provide a unique and insightful perspective into how society recognizes and structures itself (Facciani, Warren and Vendemia). Just as Darowski considered representations of race in comics, the present work considered representations of organizational structures in comics. Empirically testing network theories across an entire (albeit fictional) universe, this study helps reveal structural and individual properties that may shape the ever-increasing number of team-ups, crossovers, and collaborations that occur in the pages of Marvel comics and subsequent media (e.g., the Marvel Cinematic Universe, television shows). Counterintuitively, characters most prone to collaborate across larger networks were not innately 'team players,' powerhouses with the most destructive skill set, or even those with the longest publication history (e.g., the superspy [not winged] Angel, the mystic [not superspy] Black Widow). Instead, network analysis revealed (a) independent characters are more likely to bridge and connect networks and (b) there is a positive curvilinear relationship between organizational tenure and network spanning. Such findings help explain the popularity of current characters like Deadpool and Squirrel Girl: Such characters have been established and popularized, and prefer to run solo and thus are free to temporarily join up with Cable, Galactus, or Howard

the Duck for a single issue or brief story arc before returning to free agency. Rather than having to explain why Cyclops is teaming up with the Avengers without referencing other X-Men, Venom can be brought into or out of a group without additional explication (or licensing rights from Sony). Moving forward, writers, readers, and even managers may consider that the greatest collaborators may actually be some of those who seem to be least connected to the group.

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