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# Captain Dorito and the Bombshell: Supernormal Stimuli in Comics and Film

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We examined the visualization of male and female superheroes, paying attention to physical dimensions and costuming that accentuated hyper-masculine or hyper-feminine features such as shoulder-to-waist ratio, jawlines, upper body muscularity, waist-to-hip ratio, and breast morphology. Body mass index (BMI) data were collected for 3,752 Marvel comic characters. Males were on average “obese” whereas females averaged at the low end of normal weight. The male higher body mass was caused by extreme upper body muscularity, with male shoulder-to-waist ratios far above human limits. This is in stark contrast to low weight female superhero bodies with far lower waist-to-hip ratios than average humans. The endocrine markers that are exaggerated in these depictions create supernormal sexual stimuli for each sex.

## ***Public Significance Statement***

An examination of over 3,000 comic book characters and hundreds of drawings found that male characters were huge and well beyond the normal range for shoulder-to-waist ratio, resembling and exaggerating the Captain Dorito meme (the concept that Captain America, as played by Chris Evans, has the shoulder-to-waist ratio of a triangular Dorito corn chip). Female bodies were uniformly thin and hyperfeminine, with waist-to-hip ratios smaller than the most sought-after porn actresses. These bodies can be thought of as supernormal stimuli; exaggerations of what humans have long found attractive.

**Keywords:** comic books, waist to hip ratio, shoulder to waist ratio, body mass index, supernormal stimuli

There is no question that superheroes have permeated the global cultural consciousness.

Comic book characters, particularly due to their recent cinematic incarnations, can be seen on all forms of media and merchandise. In addition, the same characters are being incorporated into fan art, fan fiction, and fan created memes that further their reach and impact on the culture. These various depictions share the same characteristics, extremely masculinized, muscular men and feminized, curvy women.

These characters have been criticized for the past 20 years for being depicted in a particularly hyper sexualized way (Avery-Natale, 2013; Baker & Raney, 2007; Pennell & Behm-Morawitz, 2015; Taylor, 2007). However, the literature is lacking investigation into how the characters have become hypersexualized or

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what features should be examined. Likewise, criticism has been focused on female characters, and specifically on breasts, while other markers of femininity and markers of masculinity have been largely ignored. In addition, much of this research has been done without measurement of physical characteristics, using rating scales of subjective opinions such as “larger than normal.” How do comic book characters actually measure up to human bodies, and what bodily features or physical measurements are actually exaggerated? Are there limits to this exaggeration? After the questions of how these figures have been exaggerated have been answered, we can move on to why this exaggeration is desired (and profitable).

Avery-Natale (2013) examined this “hyper-masculine character presentation of male characters and a hyper-fetishized and hypersexualized presentation of female characters” (p. 72). Avery-Natale (2013) also commented on how these gender signifiers become so extreme they no longer accurately depict human bodies, and become “simulacra.” We argue a more accurate term is *supernormal stimuli*. Supernormal stimuli (or simply *superstimuli*) are exaggerated versions of stimuli that already elicit responses, so much so that they create a stronger response than the original stimuli. This work originated with Niko Tinbergen, and his discovery that one could exaggerate a stimulus to such an extent that it could elicit an abnormally strong response. The most well-known example was that of baby gulls that would prefer to peck at brighter red objects rather than the red parent gull beaks (Tinbergen & Perdeck, 1950). “Essentially, a supernormal stimulus is so exaggerated that it can create a stronger pull than the actual stimulus” (Barrett, 2010, p. 3). This has already been investigated in exaggerations of the human form (Barrett, 2010), in particular, Doyle and Pazhoohi (2012) found that the most desired augmented breast size and shape was actually not a natural but an exaggerated shape. Others have examined facial features (Costa & Corazzo, 2006), cosmetics (Etkoff, Stock, Haley, Vickery, & House, 2011), and the effect of high heel shoes (Morris, White, Morrison, & Fisher, 2013). To investigate these supernormal stimuli, the markers that are exaggerated to create hypersexualized and markedly different bodies need to be delineated.

## Male Bodies

The masculinity (and hypermasculinity) of superhero comic book characters is not new (Avery-Natale, 2013). Superman, created in 1938, represented the idealized male body according to his creators, and in very few instances have comic book heroes been depicted as anything but hyper masculine (Baker & Raney, 2007). In addition, the costumes that emphasize masculine features in comic books are not new and do not vary a great deal. They mimic the costume of warriors, soldiers, and other figures of authority or dominance. Indeed, military personnel and heroes share behaviors and purposes (detecting threats, fighting adversaries, protecting communities, achieving status in hierarchies). These costumes (and also the physical markers) are used to display dominance in size, muscularity, and markers of testosterone (see below). As Weltzien (2005) writes, “The superhero costume is an imitation of the historical models of the warrior, the classic domain of heroic manhood” and the superhero costume, much like an authority’s uniform, allows the hero to do things others cannot. Military uniforms and superhero costumes share the same features; V shaped designs and shoulder adornments that accentuate the shoulder-to-waist ratio (SWR), a marker of testosterone levels and dominance (Mazur & Booth, 1998). Weltzien (2005) even made the point that the classic (and common) act of superheroes ripping their clothes off to reveal their hero costumes is a masculine display, particularly Superman ripping open his shirt, revealing the broad “S” across his chest. The often baggy or concealing pedestrian disguise is ripped away, revealing a skintight, muscle displaying, V accentuating hero costume. It is important to note that it is the shirt that is often ripped open to show a broad chest; all other parts of the disguise would have to taken off as well, but this is never shown.

The recent further exaggeration of these features and the creation of supernormal stimuli has occurred because the technology to create it has improved. This progression of more muscular male bodies has been occurring through the late 20th century in all realms of media (advertisements, magazines, TV, film, and comics). Leit, Pope, and Gray (2001) studied *Playgirl* centerfolds and found that the ideal male

body displayed had become increasingly muscular over the years. Pope, Olivardia, Gruber, and Borowiecki (1999) found that action figures (toys) such as GI Joe have become increasingly muscular over time, with many contemporary action figures having physiques more muscular than is humanly attainable. "Many modern figures display the physiques of advanced body-builders and some display levels of muscularity far exceeding the outer limits of actual human attainment" (p. 70).

Pope and colleagues (Pope, Olivardia, Borowiecki, & Cohane, 2001; Pope et al., 1999; Pope, Pope, Phillips, & Olivardia, 2000) couch these findings in terms of increased social pressures and point to the rise of gym culture and invention and use of anabolic steroids as potential causes. Although this may be true, this merely points to the mechanism by which men are attaining these bodies, not the origin of the desire to have them. In addition, the musculature may have increased, but male toys and models have always had a male shape, referred to in the literature as a mesomorphic shape (Dibiase & Hjelle, 1968; Lerner, 1972).

A mesomorphic shape is a muscular body shape, and as such shows markers of testosterone. Ectomorphic body shapes are leaner but less muscular, whereas endomorphic shapes are pear shaped and possess more body fat. As the mesomorphic body shape displays testosterone markers, it is not surprising that the preference for this body shape greatly increases in early adolescence through early adulthood (Collins & Plahn, 1988; Dibiase & Hjelle, 1968; Lerner, 1972). In fact, 100% of the male participants in the Dibiase and Hjelle study (1968) coveted the mesomorphic body type. In addition, this preference has not differed with education, race, socioeconomic class (Brotsky, 1954), or culture (Lerner & Jovanovic, 1990). It is not just greater muscularity that is preferred, but greater upper body muscularity. Approximately one half of high school boys desired larger biceps, wrists, shoulders, and chests (Huenemann, Shapiro, Hampton, & Mitchell, 1966), and college age men desired larger chests and arms (Calden, Lundy, & Schlafer, 1959). This preference provides the basis for a progression. The widespread preference for this body shape has existed for a very long time and the attainment of these bodies has become easier in recent decades, through educational and

technological advancements in nutrition and physiology (Dutton & Laura, 1989), and even body shaping clothing (Watkins & Dunne, 2015).

The attainment of these bodies in comics and film has become even easier. In the early (1940s) production of comic books, artists were financially encouraged to churn out content quickly. This created simple content (both in art and plot) that lacked detail (McAllister, 1990). Since that time (and with some volatility), comics have become remarkably profitable, and the industry has expanded and invested in artists, writers, and manufacturing. This has led to greater detail in all realms, including the depictions of characters. Improvements in materials and printing quality led to more detail and elaboration, creating greater muscle definition, and therefore more muscle, in comic books throughout the 1980s and 1990s. Avery-Natale (2013) studied the progression of DC Comic characters. In 2000, 75% of the male characters sampled had exaggerated muscles, while by his account, no male characters from the Gold Age had muscles characterized as exaggerated (*exaggerated* is a subjective term and will be discussed later).

The improvement in computer generated imagery, costuming, and film production through the millennium created the opportunity to bring that hyper masculinity to film. Technological improvement in fashion enabled designers to mold muscles on costumes and create muscularity without any physical effort on the part of the actor. An obvious example would be comparing Adam West's 1960s Batman to Michael Keaton's 1989 movie version. Adam West's costume was a leotard, whereas Keaton's body was augmented with supermuscular armor (Jirousek, 1996). Ndalianis (2009) discussed the advent of computer generated imagery and the impact this has had on film animation and special effects; what is created in comics can now be easily and accurately recreated on screen, particularly in terms of movement. Improvements in physical training, nutrition, and even airbrushing have led to heroes looking more muscular on film without wearing a costume. Although we argue that these stimuli have been sought after for decades and have only now become feasible, there is no question that this iconography, if you will, serves as a reference for modern day males.

The popular meme “Captain Dorito”, in which the eponymous triangular corn chip is superimposed over a film still of actor Chris Evans as Captain America in *The Avengers* (Feige and Whedon 2012) to illustrate his SWR, is an example of how film makers and actors are succeeding in creating supernormal stimuli. This one example provides several masculine markers; the large SWR, in part created by design of the uniform (padded shoulders, tight waist, V shaped seams down the torso, large emblem centered in the chest) and in part by Evans’ own rigorous workouts that emphasize the upper body, his angular jawline, tall stature, posture and other markers creates a hypermasculine figure. This meme has been shared broadly since its first post in May 2014 (after the release of *Captain America: The Winter Soldier*; Feige, Russo, & Russo, 2014). One popular version reads “#heart of gold and shoulder waist ratio of a Dorito”. It has been featured in fan art, recreated in cosplay, and even referenced by *The Avengers* (2012) actors themselves. Its popularity illustrates how viewers and readers have recognized this supernormal stimulus, this exaggeration, and celebrated it.

Little work, however, has examined how these supernormal stimuli are created or what features they are acting on. Articles may discuss musculature or body size (Avery-Natale, 2013; Young, 1991), but they fail to examine the physiological bases underlying hypermasculinity. Hypermasculine bodies (these supernormal stimuli) display exaggerated markers of testosterone.

### Markers of Testosterone

Masculine bodies feature larger size, greater upper body muscularity, and other secondary sex characteristics that are the result of testosterone (Mazur & Booth, 1998). These testosterone markers, both in body (height, upper body muscularity, high waist-to-hip ratios [WHRs]; Mazur & Booth, 1998) and in face (prominent brow ridges, angular jaws and cheekbones; Grammer & Thornhill, 1994) are indicative of higher perceived dominance (Dijkstra & Buunk, 2001; Singh, 1994). Dijkstra and Buunk (2001) found that men rated male rivals that portrayed a higher shoulder-to-hip ratio as more dominant and more attractive. These men paid the most attention to rivals’ shoulders, chest, and waist.

This triangular “Dorito” body shape exists as a result of testosterone but can be exaggerated by upper body muscularity through body building. This triangular shape is also maintained by waists and hips that are similar in size. Fat deposition on the hips, buttocks, and thighs is triggered by estrogen (not testosterone) and therefore marks a gynoid or feminine body shape (see below). Men with WHRs around .85–.95 (showing more testosterone) have been shown to be more healthy and fertile (Marti et al., 1991). In addition, several traits associated with muscularity and testosterone have been found to be heritable, including bicep size, static and explosive strength, and increased muscularity through training. In summary, these testosterone markers are displaying genetic quality and are seen as more dominant, and in many cases, more attractive (Frederick & Haselton, 2007).

The major male facial markers of testosterone that are correlated consistently with attractiveness are wide jaws and big chins and generally bigger lower faces (Grammer & Thornhill, 1994; Thornhill & Grammer, 1999). This comes as no surprise to comic book and film fans or the people who make them. *The Avengers* (2012) director Joss Whedon discussed Chris Evans’ jawline in the film’s DVD commentary, “Get ready for Chris Evans’ jaw. The greatest jaw in the film. That’s right. That’s a hero”.

### Female Bodies

Researchers have often lamented the representation of women in comic books, starting with just how little they are represented. Young (1991) found only 22% of Marvel trading cards focused on female characters and women heroes also fought fewer battles. Others have discussed how those characters are depicted, both physically and in terms of storyline. Female costumes are often depicted with specific accentuation of the waist, with small belts and lines and color changes to exaggerate these curves. Female costumes are also more likely to show more skin, with cutouts on the arms, thighs, and, in particular, on the chest to show cleavage. The irony of battle uniforms that serve no protective purpose has been pointed out several times in cultural studies (Cocca, 2014). Many are depicted wearing high heels which shift balance to accentuate



hip and buttock curvature (Lewis et al., 2017) but do little to help in a fight.

Female superheroes are shown as curvy; they are far less likely to appear muscular (Baker & Raney, 2007). Most are drawn with large eyes and lips and infantilized faces (Bruce et al., 1993). However, this adherence to femininity makes it more difficult to portray women as strong heroes; very few are depicted with muscles that would support their super strength or abilities. Indeed, even real-life female bodybuilders find it difficult to be viewed as feminine and feel compelled to alter their behavior (behave in more feminine ways) to compensate for their appearance (Boyle, 2005).

The accentuation of curves, lower muscularity, and infantilized features are all markers of estrogen. Avery-Natale (2013) studied these body shapes and features without explicitly stating (or possibly knowing) that they were markers of estrogen. For Avery-Natale, they were merely hypersexualized “simulacra” or ways to make women appear “sultry.” The criteria for sultry were curved eyes, dark, thick lips, and a decreased emphasis on the nose (Avery-Natale also examined other estrogen markers; long, billowing hair and large breasts). Avery-Natale found that female comic book character breasts, for example, were exceptionally large and unrealistic in size and position (high on the chest and not sagging, even with extreme size and weight). Avery-Natale (2013) found that by 2000, 43% of the female characters sampled had large breasts (drawn as roughly the same size as the woman’s head), and an additional 24% had extra-large breasts (drawn as larger than the woman’s head), whereas there was a 26% decrease in women with medium-sized breasts (drawn as noticeable, but smaller than the woman’s head) and an elimination of drawings of small or unnoticeable breasts since the Golden Age. These types of breasts display not only estrogen, but youth, as younger breasts are more firm and round and not yet sagging from the weight (Miller & Kanazawa, 2007). Other estrogen markers (Avery-Natale’s “sultriness”) increased 40% to 55% between the Golden Age and the year 2000. Although these findings are useful, Avery-Natale did not explicitly account for the increase in detail on comic book depictions or discuss how this greater detail would affect estrogen markers. Indeed, Avery-Natale (2013) did not explicitly examine estrogen

markers. Specific examination and measurement of estrogen markers, like WHR, is needed.

### Markers of Estrogen

Because of increased estrogen, healthy premenopausal women possess more fat deposited on the lower body, including the hips, thighs, and buttocks (Braun & Bryan, 2006). This fat deposition creates a body shape with the hips being significantly wider than the waist; a body shape studied for decades by Dev Singh (Platek & Singh, 2010; Singh, 1993, 1994; Singh & Luis, 1995). Women with WHRs of .60 to .70 (the waist being 60% to 70% of the hips) are more consistently rated as highly attractive by men, and women with WHRs higher than .85 are less consistently rated as attractive (Bleske-Rechek, Kolb, Stern, Quigley, & Nelson, 2014; Dixon, Dixon, Li, & Anderson, 2007; Platek & Singh, 2010; Singh, 1993, 1994; Singh & Luis, 1995; Thornhill & Grammer, 1999). In addition, low WHRs in women activate reward areas in the male brain (Platek & Singh, 2010).

WHR is not just an attractive feature. It is attractive because it is an accurate indicator of reproductive viability: a 0.1 increase in WHR decreases the probability of conception per cycle by 30% (Singh, 1993). Women with high WHR (0.8 or higher) have significantly lower pregnancy rates (Singh, 2002). WHR also increases after menopause as reproductive hormones decrease (Singh, 2002). In short, WHR has not only been considered attractive for reproductive reasons, it has been considered attractive throughout the world and over millennia because it denotes reproductive viability (Singh, 2006). This is a human universal that has clear evolutionary bases.

Other markers of estrogen (like those listed above) include a high forehead, large eyes, small nose and a small chin (Johnston & Franklin, 1993), and a smaller lower face (Grammer & Thornhill, 1994; Johnston & Franklin, 1993). Breast size and symmetry is also widely studied, with breast symmetry not only being considered attractive, but an indicator of lactation ability (Grammer, Fink, Møller, & Thornhill, 2003).

This study examined how bodies are depicted in comic books and the extent to which they are hypermasculinized (with extreme markers of testosterone) or hyperfeminized (with extreme

markers of estrogen). As stated previously, there has been a great deal of commentary on body shapes, but measurements have often been subjective. This study intends to create quantifiable measurements of testosterone and estrogen markers in the Marvel Comic Universe; to examine just how exaggerated those body shapes have become.

Marvel comics was chosen as it has long dominated the comic book industry (McAllister, 2001) and depicts over 15,000 characters ([www.Marvel.com](http://www.Marvel.com)). It is the largest, most mainstream, and most profitable comic book brand. There are reasons for this success. We argue the popularity of Marvel characters lies not only in storyline and character development, but in depiction, as artists have created supernormal stimuli in these characters. To prove this point, we must determine how, and where, those depictions are exaggerated. It was predicted that the exaggerations would be specific to markers of reproductive hormones and secondary sex characteristics.

Specifically, a database of Marvel Comic characters was created compiling heights and weights for male and female characters to examine sex differences in these features and body mass index (BMI). Specific comic panels and film stills were also selected to measure SWR, shoulder to hip ratio, and WHR in men, as well as chest to waist ratio, and WHR in women (breast size and morphology will be investigated in future studies). Comparisons between comic book characters and the actors who play them will be used to illustrate how supernormal these stimuli have become.

## Method

The Marvel Universe database we compiled was checked for duplicate listings or measurements. After compiling all possible characters, the sample consisted of 17,707 characters.

### Measuring Bodies

Only adult humanoid forms were selected. Animals (dragons, evil cows, teleporting bulldogs), half animals, children, floating brains, robots, cosmic gases, and other entities (e.g., Marcus the Diabetic Gladiator Centaur Werewolf with a Symbiote and Robot Legs) were removed. Gods (and Asgardians) were re-

moved, as their body masses were not human in scope. If a God took a human form, those measures were used. If one body had many superhero aliases, only one body measure was included (e.g., Elizabeth Braddock, known best as "Psylocke", possesses several different names or aliases in her storyline). If one superhero alias was used by many bodies (people), those body measures were collected (e.g., several people carry the mantle of the "Iron Fist" or "Captain America"). If a body could change in size and morphology, this was treated as two bodies (e.g., Bruce Banner transforming into the Incredible Hulk). Bodies/characters from alternate universes were included if bodies were different (e.g., Earth 616, Earth-199999, Earth-1610). Heights and weights were recorded using [Marvel.com](http://Marvel.com), the Marvel Encyclopedia (Defalco, et al., 2014), and Fleer Marvel Trading Cards as sources. A total of 3,272 characters had heights and weights recorded.

### Male Body Measurements

Drawings and comic book panels of males were selected on the following criteria: shoulders and waist drawn at same angle/perspective, edges of shoulders and waist clearly visible, not obscured by armor, belts, or drape, arms drawn in downward position, both arms drawn in same position. Depictions were selected with no consideration of date of creation or publication, therefore, depictions were taken from various eras but not with a purposeful representation of all eras. In total, 214 comic book panels were found that met these criteria. SWR was measured from widest points of shoulders and narrowest points of waist. Using physiological markers like the umbilicus was not possible, as not all drawings possessed this amount of detail. Measurements were also made from the narrowest points of the waist to the widest points of the hips provided the panels had unobscured reference points.

For comparison with film actors, film stills of actors were collected that met the criteria stated above. Film posters or candid photos outside of filming were not selected as posters could be digitally altered and dates of candid photos may not be verifiable. In some cases (Captain America), uniforms increased SWR. In others (Thor), costumes decreased SWR. Whenever possible, shirtless stills were used for measurement. SWR

was measured from widest points of shoulders and narrowest points of waist following the same methods of the comic book panels.

### Female Body Measurements

Drawings/comic book panels were selected on the following criteria: waist and hips drawn at same angle/perspective, edges of waist and hips clearly visible, not obscured by costume drape, sashes or belts, legs together to get true measurement of hips. In total, 463 comic book panels were found that met these criteria. Measures were taken from narrowest points of waist and widest points of hips. As above, using physiological markers like the umbilicus was not possible as not all drawings possessed this amount of detail. Given that the comic panels were two dimensional, bust measurements were approximated by measuring from the outer most points of the left and right breasts. Future studies will examine other breast parameters.

For comparison with film actors, film stills of actors were collected that met the stated criteria. Film posters or candid photos outside of filming were not selected as posters could be digitally altered, and dates of candid photos may not be verifiable. Unlike the male actors, all film stills were of fully clothed characters. Measures were taken from the narrowest points of waist and widest points of hips following the same methods of the comic book panels.

## Results

The database of all Marvel characters consisted of 17,707 characters. Over 70% (70.6%) of the characters were male (12,495), while only 24.1% were female (4,276). A small percentage (.3%) was listed as agender and the rest did not have a gender/sex listed. A total of 3,272 characters had heights and weights recorded. Of these, 3,174 were humanoid and of these, 2,270 (71.5%) were male and 902 (28.4%) were female.

For humanoids, height ranged from 12 in. to 240 in. (1 foot to 20 feet tall) with a mean of 71.5 in. (almost 6 foot). Weight ranged from 12 pounds to 2,750 pounds with a mean of 213.3 pounds. Men were on average 73.1 in. tall ( $SD = 10.4$ ) while women were 67.5 ( $SD = 6.4$ ). Men were on average 244.9 lbs

( $SD = 199.17$ ), whereas women were 133 lbs. ( $SD = 64.3$ ).

BMI ranged from 8.22 to 317.76 with a mean of 27.84 (meeting the criteria for “overweight”, CDC.gov). Men averaged a BMI of 30.8 ( $SD = 16.85$ ), meeting the criteria for “obese” (CDC.gov). Women averaged a BMI of 20.2 ( $SD = 4.23$ ), the low range of “normal weight”. Median BMI for men was 26.38 and for women was 19.76. The range of male and female BMI is shown in Figure 1.

BMI categories of comic book characters in comparison to U.S. adults (CDC.gov) over the age of 20 years is shown in Table 1.

### Male Body Measurements

In the sample of 214 comic book panels, 155 had heights and weights available. These male characters averaged 74.64 in. in height ( $SD = 6.43$ ) and 255.72 pounds ( $SD = 114.97$ ) with an average 31.72 BMI ( $SD = 11.97$ ). SWRs in male characters ranged from 1.69 to 2.86 (waists ranged from 59% to 35% of shoulders, respectively). Mean shoulder to waist ratio for the sample was 2.168 ( $SD = .217$ ) or the waist measuring 46% of shoulders. Median SWR was 2.119. For 186 of the depictions, hip measurements were also available. Shoulder to hip ratios for the men ranged from 1.35 to 2.87 and averaged 2.006 ( $SD = .249$ ) WHRs in comic book men ranged from .47 to 1.00 and averaged .926 ( $SD = .071$ ) or waists measuring 92.6% of hips.

### Comparison to Film

Using photos taken from screen captures from film, film actors ( $n = 14$ ) had an average SWR of 1.75 ( $SD = 0.078$ ). Corresponding comic book depictions had an average SWR of 2.13 ( $SD = 0.194$ ). None of the film actors reached the average SWR of the comic sample. In fact, Chris Pratt (Peter Quill or Star Lord), Tom Hiddleston (Loki), and Aaron Taylor Johnson (Pietro Maximoff or Quicksilver) did not reach the minimum SWR in the comic book sample. None of the film actors reached the SWR of their respective comic book characters. Individual measurements (ranked in order of difference between comic SWR and film SWR) are shown in Table A1 in the Appendix.



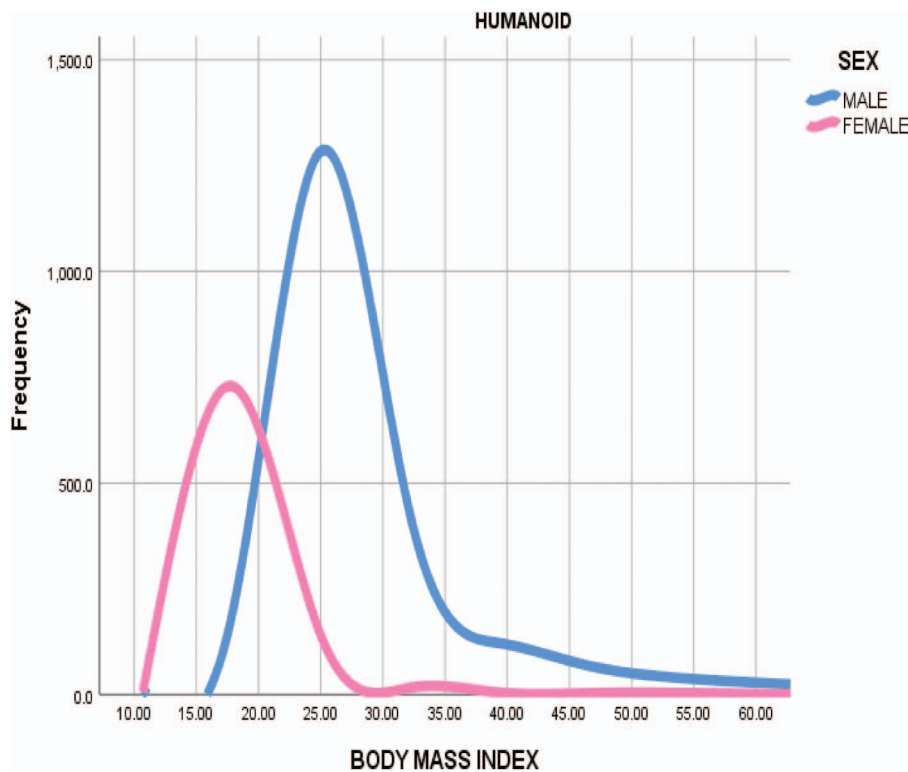


Figure 1. Distribution of body mass index in male and female humanoid comic book characters. See the online article for the color version of this figure.

Female Body Measurements

In a sample of 463 comic book panels, 323 had height and weight information available. Female comic characters averaged 68.03 in. (*SD* 3.38) in height, weighed 131.54 pounds (*SD* 23.51) and a BMI of 19.89 (*SD* 2.45). WHR ranged from .42 to .94 (waists 42% to 94% of hips). The mean comic WHR was .60 (*SD*, .073). Of these 463 panels, 191 had bust measurements available. Bust to waist measure-

ments in the sample ranged from 1.197 to 2.011 (or waist measuring from 83.5% of the frontal bust width to 49.7%, respectively) and averaged 1.5167 (*SD* = .169; or waist measuring 67% of frontal bust width).

Comparison to Film

Using photos taken from screen captures from film, film actors (*n* = 34) had WHRs that ranged from .64 to .88 with a mean of .723

Table 1  
BMI Categories

Sample	% Underweight (BMI < 18.5)	% Healthy weight (BMI 18.5–24.9)	% Overweight (BMI 25.0–29.9)	% Obese (BMI > 30)
U.S. men (over 20 years)	.9	39.3	39.9	19.9
Marvel comic men	2.2	33.8	37.0	27.0
U.S. women (over 20 years)	2.9	45.9	25.7	25.5
Marvel comic women	23.7	69.6	4.7	2.0

Note. BMI = body mass index.

( $SD = .052$ ). Corresponding comic book depictions had WHRs that ranged from .47 to .94 with a mean of .614 ( $SD, .099$ ). Although the film actor range overlapped with both the larger comic book sample and the corresponding comic depictions sample, none of the film actresses reached either average comic WHR (.60 or .61). It is important to note that the comic character with the largest WHR, Callisto (.94) was a depiction of a villainous character. As the film version was also a villain, these depictions were compared. However, when Callisto was given a more heroic (good) story arc, her depiction was more attractive, and her WHR was .61. Individual measurements are shown in Table A2 in the Appendix.

### Discussion

Obviously, these data are from the Marvel comic and cinematic universes and can only represent that population of 18 thousand characters. Other companies and titles have different target demographics and cultures, styles, and narratives and should be studied in the future. These companies do not operate in vacuums; they closely follow the preferences and trends in their markets. Research on porn (Salmon, Fisher, & Burch, in press), erotica (Salmon & Symons, 2003), and romance literature (Cox & Fisher, 2009) have shown that media marketed to males reflected male evolutionary priorities, and media marketed to women reflected female evolutionary priorities. Likewise, although larger mainstream comics follow male preferences more closely, those marketed to female consumers (usually smaller brands and titles) would be expected to follow evolved female preferences. As Marvel has long catered to a male readership, we would expect depictions reflecting male preferences; for example, the wide range of shapes and sizes that male readers can identify with, and the uniform sexiness of female characters. This has long been lamented by female critics and readers (Stotter, 2014) and may shift, as pornography has (Salmon et al., in press), as the profitability of female marketed media is recognized. This would be an area for future research, as titles like Ms. Marvel (Wilson, Alphona, Herring, & Caramagna, 2014) are being launched and garnering critical acclaim (The Hugo Awards, n.d.).

### Representation

The finding that less than a quarter of superheroes are female is not new. Young (1991) found only 22% of Marvel trading cards focused on female characters (however, this was only examining trading cards and not the entire character population). Not only are women fewer in number, there is far less variety in the shape or size they inhabit. The variance in male size (height, weight, BMI) exceeded female size by at least three times. Male characters (villain or hero) are allowed a much larger range. In the Marvel sample, only a few obese female characters were found: God Killer Super Skrull, Mariah Dillard (Black Mariah), Kristina Anderson (Thumbelina), Pearl Gross (Pink Pearl), and Big Bertha. It is important to note that all but one of these characters are villains, with Big Bertha being the only heroic character. Big Bertha weighs 750 pounds and possesses a BMI of 68.08. However, it is also important to note that Bertha's power is the ability to control her body fat, and that her secret identity is of a thin, beautiful supermodel named Ashley Crawford, who weighs 120 pounds and possesses a BMI of just 15.83. The other characters are overweight and stay overweight and are villainous and stay villainous. There appears to be a relationship between being overweight and villainy in this sample, but although there are obese men who are also villains (e.g., the Blob, Kingpin, Mojo, Slug), there also overweight heroic characters (e.g., Wong, Foggy Nelson, Volstagg, Boulder). In short, there is more variety in body shape in both good and bad male characters, but not in female characters.

There are even fewer unattractive female characters. There is such a dearth that one online forum asked if there were any unattractive female characters who were not monsters or aliens (<https://comicvine.gamespot.com/forums/gen-discussion-1/ugly-women-in-comics-570723/>). Fans could name only one (Callisto from Marvel). Not surprisingly, most commenters suggested older female characters, of which there are just a few (Cassandra Nova, Madame Web, Hag, see below). It is important to note that Callisto, along with another unattractive female character, Marrow, was a villainess. In addition, both had story arcs where they became heroic characters, and during these arcs, they both also became more attractive in predictable

ways; their faces became more infantilized, their bodies became curvier (Callisto WHR = .94 to .61; Marrow WHR = .84 to .62), and their breasts became bigger. In essence, as their characters became more attractive, their bodies followed suit.

## Bodies

The researchers found it more difficult to find male bodies that met the measurement criteria (unobscured shoulders, etc.) than female bodies because a) male characters often had large shoulder pads, armor, and accessories and b) female characters were far more likely to have skin tight costumes or bare skin. However, this still resulted in samples of over two hundred male panels and four hundred female panels. To get a clear visualization of how exaggerated, or impossible, these bodies are, we calculated body dimensions using the heights and weights of the characters and using a standard 34 in waist for males and 24 in waist for females. Male bodies measured the aforementioned 74.6 in and 255.7 pounds. Given a 34 in waist, male hips were 37 in and their shoulders were an astounding 73.71 in. Given these measurements, height exceeded shoulder by less than an inch. Comic book men were almost as wide at the shoulders as they were tall. Comic book women were 68.0 in. tall, weighed 131.5 pounds, and given a 24 in waist, measured 36 in. at the chest and 40 in at the hips. By these measurements, one could argue that the men are more exaggerated than the women (and indeed, men were more varied). This may be because female bodies are so restricted in size. There is a trade off between being curvy and being thin; they cannot be so exaggerated as to appear fat.

Lassek and Gaulin (2016) compared the bodies of college students, Playboy playmates, and imaginary women chosen by the participants from video games, graphic novels or other media, and found that imaginary women were rated the most attractive. These imaginary women could be chosen from any realm of art or media, and because they are imaginary, could possess any attributes above and beyond human women. As Lassek and Gaulin (2016) stated, “when limitations imposed by biology are removed, preferred waist sizes become impossibly small” (p. 11). Essentially, superhero women are so curvy because they can be. This

is the essence of supernormal stimuli; the impossible figures are the most attractive because they are an extreme version of what already elicits a response.

For male superheroes when the limitations of biology are removed, musculature and SWRs can become impossibly large. So large, in fact, that human actors cannot compare; none of the film actors met the average comic SWR, and a number failed to meet the minimum. For the film actors, biology does create limitations that the film industry tries to compensate for through CGI and costume design. To make it clear how costumes are created to accentuate shoulder to waist ratio, Chris Evans, in the “Captain Dorito” Captain America uniform, possessed a shoulder to waist ratio of 1.87. In an interview on “Wait, Wait, Don’t Tell Me” (Danforth, 2019), Black Panther costume designer Ruth E. Carter described the process, “Well, we take a Vac-u-form kind of mannequin version of Chadwick Boseman’s real body form, and we add the clay to his muscles, and we form a superhero kind of physique.” When the host (Peter Sagal) voices his surprise that that is not the actor’s actual body, Carter replies, “I’m telling you the secret . . . it doesn’t matter how much muscle milk you drink. You’re never going to be a superhero. You’ve got to have some clay muscles . . .” This is not to disparage the actors; they all have very high SWRs for actual humans. In this study, whenever possible, film actor measurements were made on frame captures when the actors were either shirtless or wearing tight clothing, not uniforms, to try to remove this manipulation. On average, the film actors still possessed a SWR of 1.75 ( $SD = .078$ ). Evans, Neave, and Wakelin (2006) found that among 50 college men, the average SWR was 1.12 ( $SD = .12$ ). This means that comic book men have SWR and upper body muscularity almost twice normal college men. One can argue that in the comics, male characters can also have amazing strength without size, as we see several small male superheroes and villains (Spiderman, Toad, Nightcrawler). However, when size does matter, it is exaggerated well beyond human scope. These male bodies may in fact be so large, and unbalanced, that movement in reality would be severely hindered.

Film actresses, although within the range of the comic book WHRs, cannot compete with the averages. Indeed Salmon et al. (in press)

examined the bodily dimensions of porn actresses, and the most sought after pornographic actresses in the world (according to Pornhub.com) had WHRs of .67, well below the average human, but well above the average comic book woman at .60. Comic book heroines are curvier than the top five sought out porn stars in the world on a site that logged in 25 billion searches. This also gets to the heart of the supernormal stimulus; the exaggeration of a stimulus that already elicits a response. Platek and Singh (2010) have shown that viewing low WHR elicits a response from the reward areas of the male brain. Singh (2006) found that statues from ancient civilizations showed the same preference for low WHRs. Singh (2006) states that “the hourglass figure is not a novel or recent phenomenon shaped by the mass media; allure of the hourglass figure is evident across generations in ancient cultures.” (p. 359). One could easily argue that humans have been creating supernormal stimuli for as long as this preference has existed.

As we stated previously, most comic book women are depicted wearing high heels, which shift balance to accentuate hip and buttock curvature (Lewis et al., 2017). Although this was not the focus of this study, it is important to note that a brief review of the female depiction sample found that when women were wearing shoes and drawn from an angle that displayed the heels of the feet, 90% of the female characters were wearing heels. In addition, even when the women were not wearing shoes, they were drawn as walking on the balls of their feet, creating the look of high heels without wearing them. Interestingly, researchers have already argued that women in high heels could be regarded as supernormal stimuli (Morris et al., 2013). The irony of this is that these are imaginary women, and can be drawn with accentuated hip and buttock curvature without ‘wearing heels’. Still artists draw them in this way. The very few cases where female characters were wearing flat shoes could mostly be categorized as prepubescent/pubescent girls or masculine/unattractive women (Titania, Godkiller Super Skrull, Callisto before her transformation into a good character). More work can be done on this, particularly regarding foot size, the role of character morality, reproductive status, or even why women are so often drawn not wearing shoes at all.

In summary, what these data show are drawings that are meant to exaggerate the male and female form while remaining aesthetically pleasing. These depictions trigger the same reactions to male and female bodies, if not more so, by exaggerating the endocrine markers that differentiate the sexes. They exaggerate SWRs, WHRs, heights, and weights to create supernormal stimuli. Readers are drawn to these depictions even when they are physically impossible.

### Further Research

In addition to what has been mentioned above, a great deal more work needs to be done in the measurement and study of comic book bodies. Decades of depicting the human, or humanoid, form should provide measurable samples for any endocrine marker. Other markers of testosterone or estrogen, such as jawlines, specific muscles, breasts and pectoral muscles, facial features (eyes, lips, noses), feet, and hair are in ample supply and are depicted in measurable ways. Costa and Corazza (2006) discussed a suite of facial features that artists diminish (lower face roundness) or exaggerate (eyes and lips) when asked to create more attractive or supernormal faces in portraiture. Applying these findings onto comic book faces would be particularly interesting. In addition, although much of this work has been done on female supernormal stimuli (Costa & Corazzo, 2006; Doyle & Pazhoohi, 2012; Etcoff et al., 2011; Morris et al., 2013), little work has been done on the creation of male supernormal stimuli. What neurological response would be elicited by these dramatically exaggerated male comic book bodies (like Platek & Singh, 2010)? What if the film actors’ bodies were compared using hero depictions and roles versus less physically fit roles?

Obtaining quantifiable measures of representation and diversity in mainstream comics would also be of interest, particularly those who do not fit the strict depictions found in the results of this study. Depiction of prepubertal characters is of interest, and in particular, how their depictions and characters shift after puberty. In the Marvel universe, overweight, unattractive, or older women with power or agency are rare. How are they depicted? From this sample we can see that older women are rarely represented. The older women repre-

sented in comic books are often either caregivers (Aunt May), victims, or villains (Cassandra Nova, Madame Web, Hag). This study included depictions of two postmenopausal characters in its measurements of female bodies (Madame Web and Hag). Both were old women (and villains), yet both had premenopausal bodies, with WHRs of .51 and .59, respectively. Once again, it appears that limitations imposed by biology are removed, yet aesthetic limitations remain. If older women exist, they rarely look the part. Are male characters more likely to age? What do comic book depictions of older (and younger) characters tell us about aesthetic preferences, reader interest, and profitability?

The majority of overweight female characters in the sample were villains. Both Callisto and Marrow had significant physical changes when they shifted from villainous to heroic figures. Although it has been alluded to, this article has only examined overall character depictions, and did not investigate the role of character archetypes and storylines in how characters are depicted. More work has to be done in this area. For example, how does the depiction of a character change if they become heroic or villainous? If a character becomes physically scarred, but remains a hero, does that scar also remain, or does it heal, allowing the character to remain beautiful? Are villains more likely to remain scarred? Are villains more likely to age? Are male characters more likely to age?

Another area for future research involves the super powers themselves. Male characters are often depicted as extremely muscular regardless of what their power is. Even Professor X is depicted as muscular, although his powers are telepathic/telekinetic in nature and he is paralyzed. Female characters are depicted as thin yet curvy (and not very muscular) regardless of what their power is. Superheroines, moreover, have amazing strength without size or musculature, because limitations imposed by biology are removed. Yet they cannot be muscular, as aesthetic limitations remain (see Boyle's [2005] findings on female bodybuilders). By aesthetic limitations, we mean the preferences of the target audience and the profitability that comes from following those preferences. With the exception of She-Hulk and a few other female characters, women who are strong rarely show it in their body shapes. Because female bodies are so restricted, they fail to actually reflect

what it would be like to have a particular power. Online forums have discussed how female bodies do not match the physical powers they possess, and how female characters more often have powers that do not require muscularity (like mental or magical powers) so that their aesthetic limitations are not challenged. Future work should examine the relationships between depictions of bodies and the powers they possess. Although one may argue that these super-beings are just that, and may effortlessly possess superpowers, body depictions follow preferences for secondary sex characteristics, and not actual powers or effects of those powers.

It is also important to investigate the role of the artist; do artists of different genders depict characters in noticeably different ways? And finally, as comics are part of an enormous entertainment industry, studies of what characters are popular, which titles sell, and how those bodies are depicted would be of great interest. One could map the relationships between target audiences, character depictions, and profitability of those characters. Given that comics have largely been marketed to a male audience, it is not surprising that there are more, and more diverse, male characters, while female characters are uniformly sexy.

In summary, a great deal more work needs to be done studying how hero and villain archetypes are depicted in comics and film, and how these supernormal stimuli affect readers and audiences. Some would argue that exaggeration met its limit with Rob Liefeld's depictions of comic book heroes in the early 1990s, described by Knowles (2007) as "Instead of sleek, idealized athletes, with colorful yet tasteful outfits, superheroes became a riot of bulging veins and ballooned muscles" (p. 7). However, this exaggeration continues and film, mostly through costuming and CGI (as biology has its limits), is trying to catch up. At what point does a supernormal stimulus become so exaggerated that it can no longer elicit a response?

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(Appendix follows)

Appendix

Comparison of Comic Book Character and Film Actor Measurements

Table A1  
*Comparison of Male Film and Comic Characters*

Character	Comic SWR	Actor	Film SWR	Difference
Winter Soldier	1.8614	Sebastian Stan	1.7627	.0987
Captain America	1.8973	Chris Evans	1.7500	.1473
Black Panther	2.1112	Chadwick Boseman	1.8846	.2266
Ant Man	1.9713	Paul Rudd	1.7438	.2275
Star Lord	1.8926	Chris Pratt	1.6426	.2500
Vision	2.0445	Paul Bettany	1.7728	.2717
Heimdall	2.0093	Idris Elba	1.7087	.3006
Spiderman	2.0188	Tom Holland	1.7008	.3180
Drax	2.0989	Dave Bautista	1.7787	.3202
Loki	2.1020	Tom Hiddleston	1.6853	.4167
Kilmonger	2.3776	Michael B. Jordan	1.9512	.4264
Thor	2.2523	Chris Hemsworth	1.8048	.4475
Hawkeye	2.2698	Jeremy Renner	1.7155	.5543
Quicksilver	2.2461	Aaron Taylor Johnson	1.6650	.5811
Deadpool	2.3916	Ryan Reynolds	1.7137	.6779
Wolverine	2.5122	Hugh Jackman	1.7299	.7823
Average	2.1286		1.7506	.3779
SD	.1946		.0788	

*Note.* SWR = shoulder to waist ratio.

(Appendix continues)

Table A2  
*Comparison of Female Film and Comic Characters*

Character	Comic WHR	Actor	Film WHR	Difference
Callisto	.9407	Dania Ramirez	.6900	-.2507
Karen Page	.8521	Deborah Ann Woll	.7411	-.1110
Quake	.7169	Chloe Bennet	.7257	.0088
Wasp	.6949	Evangeline Lilly	.7083	.0134
Okoye	.7481	Danai Gurira	.7687	.0206
Shuri	.6165	Letitia Wright	.6575	.0410
Rogue	.6461	Anna Paquin	.6881	.0420
Mystique	.6489	Rebecca Romijn	.6917	.0429
Nebula	.5890	Karen Gillan	.6483	.0592
Emma Frost	.6250	January Jones	.6880	.0630
Hela	.6173	Cate Blanchett	.6821	.0648
Deathstrike	.6587	Kelly Hu	.7316	.0729
Maria Hill	.6742	Cobie Smulders	.7517	.0775
Viper	.5852	Svetlana Khodchenkova	.6682	.0830
Valkyrie	.6000	Tessa Thompson	.6977	.0977
Psylocke	.6391	Olivia Munn	.7407	.1017
Malice	.6174	Lupita Nyong'o	.7248	.1074
Storm	.5939	Halle Berry	.7095	.1156
Scarlet Witch	.5538	Elizabeth Olsen	.6744	.1206
Melinda May	.5972	Ming Na Wen	.7209	.1238
Elektra	.5811	Jennifer Garner	.7059	.1248
Moirra MacTaggart	.5948	Rose Byrne	.7364	.1416
Mantis	.4892	Pom Klementieff	.6370	.1478
Medusa	.5248	Serinda Swan	.6831	.1583
Black Widow	.5298	Scarlett Johansson	.7063	.1765
Invisible Woman	.5279	Kate Mara	.7083	.1804
Kitty Pryde	.6916	Ellen Page	.8750	.1834
Gamora	.4916	Zoe Saldana	.6982	.2066
Pepper Potts	.5225	Gwyneth Paltrow	.7343	.2117
Gwen Stacy	.5413	Emma Stone	.7614	.2201
Mary Jane	.5319	Kirsten Dunst	.7625	.2306
Mockingbird	.6389	Adrienne Palicki	.8762	.2373
Misty Knight	.5328	Simone Missick	.7768	.2440
Jean Grey	.4737	Famke Janssen	.7746	.3009
Average	.6143		.7219	.1076
<i>SD</i>	.0986		.0528	

*Note.* WHR = waist-to-hip ratio.

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