Superhero adventures and the representation of science: a historical look at film adaptations of The Incredible Hulk during the 1970s and 2000s

Fernando Alves da Silva Filho[i]

[i] PhD candidate in Biosciences and Health Education, Instituto Oswaldo Cruz/Fiocruz. Rio de Janeiro – RJ – Brazil

orcid.org/0000-0001-9468-4340

ffilhotouche@gmail.com

Luisa Massarani[ii]

[ii] Coordinator of the Instituto Nacional de Comunicação Pública da Ciência e Tecnologia; professor, Casa de Oswaldo Cruz/Fiocruz; advisor to Fiocruz's Vice-President for Education, Information, and Communication. Rio de Janeiro – RJ – Brazil

orcid.org/0000-0002-5710-7242

luisa.massarani@fiocruz.br

Erik Stengler[iii]

[iii] Professor, Cooperstown Graduate Program/State University of New York. Oneonta – NY – USA

orcid.org/0000-0001-9232-3277

erik.stengler@oneonta.edu

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Abstract

Film productions offer different representations of science and scientists. This study investigates how science and scientists are represented in superhero adventure narratives, particularly in The Incredible Hulk films. Four films were analyzed: two from the 1970s, when the first movies portraying this superhero were released, and two from the early twenty-first century as the Marvel Cinematic Universe expanded and superhero movies were frequent blockbusters. The specific goal was to examine how representations of science and scientists in the Hulk films have changed over time.

Keywords: superhero adventures; science communication; scientific culture; superheroes; social representation.

Superhero adventures are born

From 1896, cheap, low-quality magazines were successful in the United States. At prices ranging from five to 50 cents, they contained science fiction, horror, detective, Western, mystery, and adventure stories (Gresh, Weinberg, 2002, p.XII).

America in the 1930s was marked by the Great Depression, with unemployment, widespread poverty, a crisis in basic food and raw materials production, and limited entertainment options. This led to the appearance and establishment of a new writing genre, superhero adventures: stories blending all the genres in the cheap magazines that had already been a success in the market since the turn of the previous century (Gresh, Weinberg, 2002). A milestone for superhero adventures was the launch of *Action Comics* n.1, in 1938.

Specifically, two failing newspapers (*New York World* and *New York Journal*) published these stories as a strategy to prop up their sales and engage their readership (Robb, 2017). Against this backdrop, adventure, suspense, mystery, and science fiction stories appeared in daily publications and influenced the imagination of writers, editors, designers, and especially young people (who were looking for work in a labor market with few opportunities), reflecting the economic and social conditions of that era.

Superhero adventure publications moved through various stages from their emergence to large-scale worldwide success in the twenty-first century. They were very successful in the 1940s and 1950s, but in the 1960s psychiatrists and family organizations opposed the content of these stories, declaring them inappropriate for children and young people. Sales dropped significantly in the 1970s, bringing the genre to the brink of bankruptcy. But superhero adventures reemerged during the 1980s and 1990s, as creators and writers blended fiction and reality to create easily recognizable narratives and attract different audiences (Gresh, Weinberg, 2002; Robb, 2017). Some characters were connected to social issues: Superman (with immigrant roots and the existential crises of ordinary people), Batman (fighting organized crime), Captain America (issues of war and genetic engineering), Wonder Woman (feminist struggles and the position of women in society), Black Panther (Black and ethnic minority movements), and X-Men (which addressed a variety of topics ranging from social psychology to xenophobia and homosexuality) (Gresh, Weinberg, 2002; Robinson, 2004; Reblin, 2008; Irwin, 2009; Robb, 2017). But one of the best examples of identification between readers, social themes and a character was Spider-Man, "a tremendous hit with readers because it gave millions of teenagers a hero with whom they could identify" (Gresh, Weinberg, 2002, p.67) when talking about issues such as school, bullying, and the torments and transitions of adolescence.

Superheroes were born and popularized in the pages of comic books, but over the years their stories were adapted for various media: radio programs, television series, movies, theater, video and online games, and animation.

From the start, superhero adventures have been written for all audiences, addressing adult subjects and themes even though children and adolescents have been the main consumers. Still, when these readers reach adulthood, many lose interest in the stories or are ashamed to enjoy this kind of entertainment (Viana, Reblin, 2011). It was during the

early 2000s, especially with the creation of the Marvel Cinematic Universe and movies based on convergence culture (Jenkins, 2006), that superhero adventures broke free from the stigma of being limited to children and adolescents (Gresh, Weinberg, 2002; Costa, 2007; Reblin, 2008; Irwin, 2009; Viana, Reblin, 2011; Robb, 2017), with major box office successes. Thanks to special effects and technology, film productions began to offer plausibility (Kirby, 2011, 2014) and visual realism to the possibilities illustrated in the comic book pages.

Films and science: stereotypes and representations in cinematography

Science and scientists have been present in cinema since the first sci-fi and horror films. Lacy Barca (2005, p.31) points out that the "love affair between cinema and science is very old;" *Le voyage dans la lune*, 1902, directed by Georges Méliès, is the film in which "the first representations of scientists appeared in cinema" (p.32).

Reznik, Massarani, and Moreira (2019, p.754) note that "science took on a central role in society," especially during the twenty-first century. Representations of science are directly linked to the scientific culture, with its distinct values, attitudes, and social and cultural practices. Within this context, film productions have become a tool for popularizing scientific practices among different audiences, even if in many cases this was not the filmmakers' intent. At times filmmakers even enlist scientific consultants to blur the lines between science, fiction, and mysticism; these professionals are responsible for ensuring that the portrayals of science in films are not "fiction" but rather in line with reality (Kirby, mar. 2003). According to Reznik, Massarani, and Moreira (2019, p.755) "the image of science and scientists in films ... is filled with symbolic, complex, and sometimes contradictory elements that evoke historical and mythical narratives but are also anchored in the impacts of science on society."

Because it is unfeasible to bring everyone into laboratories, paleontology sites, nuclear power plants, or other scientific locations, films have become one of many ways to more comprehensively reach greater numbers of people. Even if the purpose is not science communication, Kirby (mar. 2003, p.56) states that "by claiming scientific legitimacy for their films through the use of science advisors, filmmakers add to the 'naturalizing' effect of cinema." In this way, films enhance the understanding of routes to scientific articles, laws and debates that affect society.

Even when movies are created as entertainment, they have often presented conceptions of science and scientists that are based on stereotypes. Haynes (jul. 2003), in analyzing films depicting everything from medieval alchemists to postwar nuclear physicists to modern-day hackers, lists seven stereotypes of scientists in films: (1) the evil alchemist, (2) the noble, hero scientist, (3) the foolish scientist, (4) the inhuman researcher without emotions, (5) the scientist as adventurer, (6) the mad/bad/dangerous scientist, and (7) the helpless scientist, all of which will be described below.

Flicker (2003) analyzed sixty films to understand how representations of women scientists changed in movies from 1929 to 1997. This analysis was based on the stereotypes pointed out by Haynes (1994) in *From Faust to Strangelove – Representations of the Scientist in*

Western Literature, and indicated that they are not valid for both genders. Flicker lists six stereotypes that describe women scientists represented in films: (1) the old maid, (2) the male woman, (3) the naive expert, (4) the evil plotter, (5) the daughter or assistant, and (6) the lonely heroine (further described below).

The use of different images of scientists has been changing and adapting along with innovations in cinema and society itself over time. Changes in stereotypes about scientists and notions of science which began in science fiction books have reached films and TV series. These new representations were motivated by research in genetic engineering, women's growing participation in science, and concerns about how representations of science could impact young viewers (Steinke, 1999, 2005; Barca, 2005; Haynes, jun. 2014).

Superhero adventures and science: science fiction and adventure in movies

In the late 1930s, when superhero adventures were created, there were few differences between scientific heroes, magicians and the supernatural. But in the 1950s and 1960s, representations of science in science fiction literature became more accurate (Gresh, Weinberg, 2002, p.XVI-XVII) for two reasons: first, during wartime, science and scientists were important to military strategy, and second, "science was seen as the only solution for human beings" in a strategy to capture funding and sponsorship for the space race between America and the USSR (Vieira, 2007, p.63).

In over 80 years of superhero adventure publications, we can see latent relationships between these stories about superheroes and scientific concepts during different historical periods. The authors of this genre were inspired by literature and representations of the reality in which they lived. Through imagination and creativity, they translated these elements into fantasy stories that subtly (or not-so-subtly) reflected the society, politics, culture, and scientific knowledge of their times (Viana, Reblin, 2011).

After the end of Second World War, the US and USSR emerged on the world stage as political, military, and scientific leaders, especially in the dispute for nuclear weapons. Although these two nations were ideologically opposed, they followed the same path for scientific development: the space race. With preventive weapons production and the space race driving the American and Soviet economies, science fiction resumed center stage in literature, cinema, and comics. And inspirations from military science and studies on radioactivity and astronomical engineering (Gresh, Weinberg, 2002; Bombara, Valenzuela, 2013; Scaliter, 2013; Robb, 2017) were fertile ground for minds that kept the comic industry active for decades until it spawned blockbuster movies and profitability in the twenty-first century.

As superhero films have become successful and reached larger audiences over the past 20 years, analyzing movies with specific attention to cultural meanings during different eras can indicate the scientific issues that were relevant when these films were produced and released. Cinema stereotypes are often used because they are easy to recognize; in other words, "audiences easily recognize caricatures of scientists" (Kirby, 2014, p.44), and fiction films expose concerns, attitudes, and social changes in relation to science and technology (Kirby, 2011, p.23) which are present in the daily life of their time.

For this reason, analysis of cultural productions, especially popular films, is important to understand what messages are being crystallized in the public understanding.

The Incredible Hulk – Frankenstein misunderstood among superheroes

This study investigates how science and scientists are represented in superhero adventure narratives, particularly films about The Incredible Hulk. This character was chosen because the narratives are based on scientific legends, constantly address scientific aspects, involve themes from different fields of science, and cover cinematographic productions from two distinct historical periods, making it possible to examine how representations of science and scientists changed between the early productions in the 1970s and the early twenty-first century.

The Hulk was created in 1962 by Stan Lee and Jack Kirby, inspired by two stories: *The Strange Case of Dr. Jekyll and Mr. Hyde* and *Frankenstein* (Viana, Reblin, 2011). These two classics of science fiction literature solidify the direct connection between superheroes and science, technology and health. The Hulk is the alter ego of scientist Robert Bruce Banner, who is an "expert in biology, chemistry, engineering, and physiology, and also has a doctorate in nuclear physics" (Scaliter, 2013, p.44) but becomes an uncontrollable monster after being exposed to a burst of gamma radiation. Over six decades, the Hulk/Bruce Banner have generated an extensive collection of comic books, films, series, and animated TV programs that cover scientific themes for audiences of different generations, realities, and tastes.

The specific goal of this study was to examine how representations of science and scientists in the Hulk films changed over time. To do so, we selected four Hulk films from two different time periods: two from the late 1970s, when the character's first film was released, and two released in the twenty-first century, one from 2003 and the other from 2008.

The films selected for analysis were *The Incredible Hulk: How the Legend Began* (1977), *The Incredible Hulk: Married* (1978), *Hulk* (2003), and *The Incredible Hulk* (2008). Table 1 presents the synopsis of each film. These productions were chosen because they contain similar running times, reflecting a fair density of data for comparative analysis. The 1977 and 1978 films are 94 and 97 minutes long, respectively, a total of 191 minutes, while the 2003 and 2008 films are 138 and 112 minutes with a total of 250 minutes. Although the more recent films are longer, it is important to note that data density refers to content directly related to the central objects of the study: representations of science and scientists. The movies from the 1970s focus specifically on four characters, more objectively concentrating on our object of study. The 2003 and 2008 films have larger casts with expanded characters and scenes, and include more minutes dedicated to the narrative of elements that are not part of the subject of this present study. For this reason, we believe the density of data is equivalent for analysis.

Table 1: Plot of the Hulk movies chosen for analysis

Film 1 – *The Incredible Hulk: How the Legend Began* (1977) Directed by: Kenneth Johnson Cast: Bill Bixby, Lou Ferrigno, Susan Sullivan, Jack Colvin Synopsis: After his wife's death, Dr. David Banner (Bixby) is haunted by nightmares. With the help of Dr. Elaina Marks (Sullivan), he discovers a possible connection between cases of super-strength and gamma radiation phenomena. Meanwhile, rumors of a giant green monster (Ferrigno) terrorizing the region capture the attention of sensationalist reporter Jack McGee (Colvin), starting a search for answers about The Incredible Hulk.
Film 2 – *The Incredible Hulk: Married* (1978) Directed by: Kenneth Johnson Cast: Bill Bixby, Lou Ferrigno, Mariette Hartley, Jack Colvin Synopsis: Still plagued by the deaths of his wife and of his scientist friend Elaina Marks, without a cure for the effects of the gamma radiation that created the Hulk, and pursued by the tireless Jack McGee (Colvin), Dr. David Banner (Bixby) travels to Hawaii to enlist the help of Dr. Carolyn Fields (Hartley). But Banner soon learns she has been diagnosed with a terminal disease; the two join forces in a race against time to find a cure for their respective conditions.
Film 3 – *Hulk* (2003) Directed by: Ang Lee Cast: Eric Bana, Jennifer Connelly, Nick Nolte, Sam Elliot, Josh Lucas Synopsis: Geneticist Bruce Krenzler (Bana) works in a government laboratory conducting experiments on practical applications of gamma radiation, along with his ex-girlfriend scientist Betty Ross (Connelly). A critical failure occurs during routine maintenance on a gamma ray device, and Krenzler is exposed to huge amounts of gamma radiation. Because of experiments he was subjected to as a child the accident is not fatal, but causes the Hulk to awaken.
Film 4 – *The Incredible Hulk* (2008) Directed by: Louis Leterrier Cast: Edward Norton, Liv Tyler, Tim Roth, William Hurt, Tim Black Nelson Synopsis: News of a hallucinogenic transformation in the US leads the military to track Banner (Norton) to his hiding place, forcing him to flee and seek the help of Betty Ross (Tyler) in finding a cure for his condition while being pursued. The government is determined to find Banner, because his DNA is the key to reactivating its "supersoldier" program.

Source: prepared by the authors.

To analyze these four films, we used elements from three theoretical areas: (1) comparative analysis of films (Mikos, 2014), (2) content analysis (Bardin, 2016), and (3) analysis of representations of science and scientists (Flicker, 2003; Haynes, 1994, jul. 2003, 2006, jun. 2014; Kirby, mar. 2003, 2003, 2011, 2014; Reznik, 2017) specifically present in superhero films, based on social representation theory (Moscovici, 2015), as will be detailed below.

The references for constructing the analysis protocol were based on previous works focusing on audiovisual media conducted by the Brazilian National Institute of Public Communication of Science and Technology (Instituto Nacional de Comunicação Pública da Ciência e Tecnologia, INCT), of which this study is a part.

The following section discusses the methodology used to construct the study; the objective is a step-by-step description of each of the phases within the processes of definition, corpus definition, and analysis.

The Mikos Protocol – the super toolbelt of analytical utilities

As part of the methodology to analyze the films, especially with regard to the workflow, we formulated a series of parameters divided into three major stages and 14 steps, which we called the Mikos Protocol after the work of Lothar Mikos (2014) and his visual media studies.

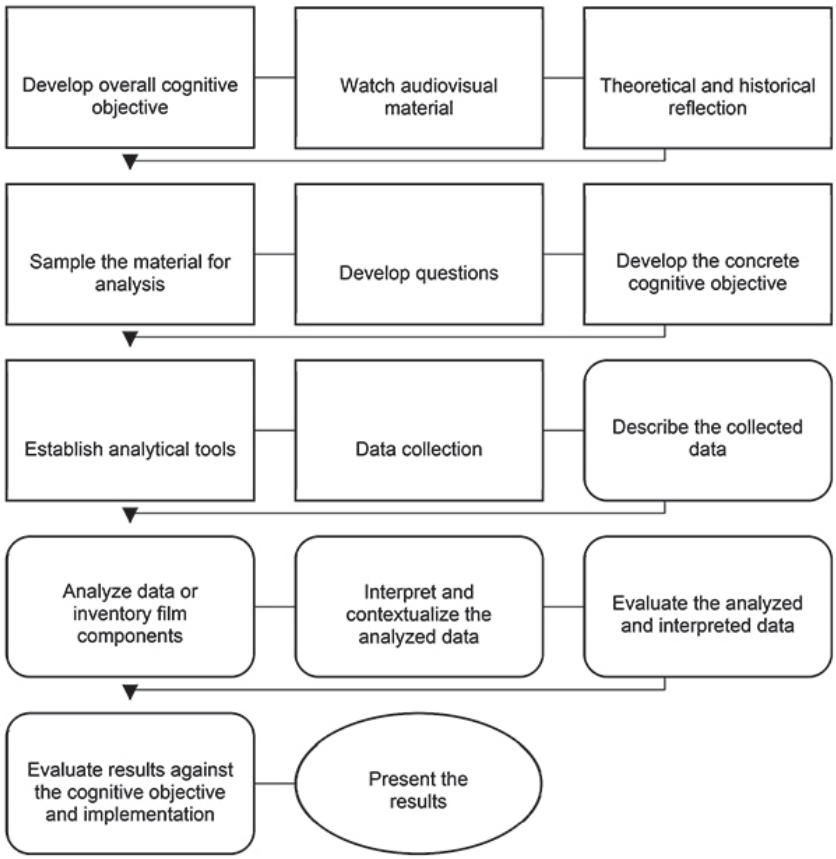

Figure 1: Workflow based on the Mikos Protocol (2014) (Source: prepared by the authors)

The first stage, which includes steps 1 to 8, lays the groundwork for the analysis or, in the scope of Bardin (2016, p.31) content analysis, is the pre-analysis that "corresponds to a period of intuitions, but aims to systematize the initial ideas and make them operational in order to guide a precise plan for development". In this stage, we defined and prepared the material to be analyzed (steps 1 to 6), the analysis tools (step 7), and collected the data to be analyzed (step 8), as described below:

- Step 1 – Develop an overall cognitive objective: define the theme to be analyzed in the films, in other words, analyze the social representations of science and scientists in superhero films and how such representations changed from the 1970s to the early twenty-first century.
- Step 2 – Watch the audiovisual material: we watched as many films as possible on the research topic and read various articles and books on the subject. For this study, we watched all the movies from the Marvel Cinematic Universe released at this time. We also watched films based on DC Comics adaptations, which include Superman, Batman (including animations), and a variety of superheroes from different eras. We

also watched series, cartoons, animated features, and documentaries on the subject, and read books, articles, dissertations, theses, fandoms, and some comic books for the selected film characters.

- Step 3 – Theoretical and historical reflection: bibliographic research and constructing the theoretical framework to define the theme, the objectives, the justification, and the paths that guide the analyses.
- Step 4 – Develop a concrete cognitive objective: the first step was to develop an abstract objective, a starting point, to establish and describe the theme to be developed. At this stage, the proposal was to make this abstract something concrete, to add specifics to the subject. After watching the films and reading various superhero stories, the concrete objective became the comparative analysis of Hulk movies, two from the late 1970s and two from the early 2000s (2003 and 2008).
- Step 5 – Develop the research questions: after defining the film material and theoretical framework, we needed to formulate the research questions. The questions addressed in this research are: (1) how were science and scientists presented in superhero films (namely, the Hulk movies) and (2) how did these representations change over time?
- Step 6 – Sampling the material for analysis: choosing the films to be analyzed. We chose the Hulk films, firstly because the character was inspired by famous stories that involve science, technology, and health, specifically *Frankenstein* and *Dr. Jekyll and Mr. Hyde*. Furthermore, there are films for this character from two different periods in time. The films chosen were *The Incredible Hulk*: *How the Legend Began* (1977), *The Incredible Hulk: Married* (1978), *Hulk* (2003), and *The Incredible Hulk* (2008), shown above in Table 1.
- Step 7 – Establish the analytical tools to be used in analyzing the films. Considering the objectives, we chose Moscovici's theory of social representations, Bardin's content analysis, the stereotypes of scientists described by Haynes and Flicker, characteristics of science listed by Reznik, and the focus on Kirby's cultural meanings.
- Step 8 – Data collection: in this step, we explored the methodologies to prepare the following steps, codifying the material and creating the analysis categories for the study.

The second stage of our protocol, which includes steps 9 to 13, represents the main part of the analysis, exploration of the material (Bardin, 2016, p.77). During this phase, the analysis procedures and categorization operations were applied to code and identify the messages extracted from the films.

- Step 9 – Description of the data collected: data were sorted and named to indicate aspects such as content, presentation, narrative, and dramaturgy, characters and actors, esthetics, settings, and the contexts of selected scenes or excerpts highlighted in each movie.

Table 2: Dimensions and categories of the film content analysis protocol

General characteristics; characters and actors	Movie name
	Director
	Year
	Main actors
	Running time
Representation of scientists; content and representation	Presence of the scientist character
	Scientist's area of activity
	Scientist's gender
	Where scientists appear
	Scientist's age range
	Scientist's skin color
	Scientist's physical attributes
	Classic stereotypes (Flicker, 2003; Haynes, jul. 2003)
Narrative/drama; characteristics and esthetics	Frames
	Symbols of research
	Symbols of knowledge
	Indications of danger
	Indications of secrecy
Representation of science; content and representation; context	Does the film explain any scientific concepts or terms?
	Does the film address controversies (scientific or otherwise)?
	Does the film mention concrete benefits of science?
	Does the film mention promises of science?
	Does the film mention concrete damage from science?
	Does the film mention potential risks from science?
	Does the film make recommendations to viewers?
	Does the film offer context information?
	Does the film present science as a collective activity?

Source: adapted from Reznik (2017).

- Step 10 – Data analysis or inventory of the film components: here we analyze the meanings of the collected data, cross-checking the data based on the selected analytical tools and then separating them according to the categories listed. All the content in each film that can be analyzed was organized.
- Step 11 – Interpret and contextualize the analyzed data: with the data separated, organized, and categorized by film, they can be interpreted. This involves understanding the highlighted elements based on the theoretical framework, contextualizing the elements present in each production, comparing them and analyzing the data using relevant historical theories and concepts.
- Step 12 – Evaluating the analyzed and interpreted data: after interpreting and contextualizing the data, evaluation began the process of discussing what could be found in the films using the proposed analytical tools. Understanding what answers the guiding research questions, the limits and potential that this type of material, the selected methodologies, and the analysis methods can contribute, or how it can be improved.
- Step 13 – Evaluating the results against the cognitive objective and operationalization: after evaluating and interpreting the categorized and discussed data, the results

are established in accordance with the objectives proposed and how the films were analyzed. Findings are highlighted, along with reflections that can be made on the selected material, how they were approached, and the criteria chosen to achieve the results obtained.

– Step 14 – This is the third step of the protocol, and consists of presenting the results, "the treatment of results, inference, and interpretation" (Bardin, 2016, p.77-132). The entire process is summarized, from selecting the objectives to evaluating the results to presenting them to the readers. Our work was to structure the processes, findings, and negations found in the analyses in order to explain what this research represents. In this way, we can demonstrate the conclusions drawn from the analyses and produce relevant final considerations.

The research focused on analyzing characteristics observed in the films, along three lines: (1) representations of scientists (in other words, of people who work in science); (2) representations of science (scientific events); (3) narratives, pathways, and methods used by scientists to deal with events.

Representations of scientists – the people who work in science in superhero movies

In film analysis, the narrative and dramatic aspects created by directors and actors must be observed and described, in the characters, scenes, and different eras. In this study we explored the representations of scientists, taking into account the stereotypes identified by Haynes (jul. 2003, 2006, jun. 2014) and Flicker (2003). Tables 3 and 4 below present these classical stereotypes listed by these authors.

Table 3: Classic stereotypes of male scientists, as identified by Haynes

The mad scientist	A researcher outside the bounds of society; arrogant, reserved, and dangerous. Obsessed with the search for power in his research, ignores norms and social relationships. Unpredictable, determined to transcend human limits to the point of causing destruction with his experiments and research.
The helpless scientist	The victim of his own discoveries, he refuses to predict or accept responsibility for the disastrous results of his research. He ignores the likely sociological effects, hiding and redirecting his failures to avoid discovery and losing concessions and benefits.
The foolish scientist	Comical, bumbling inventor. Parodies are used to present the concept of the scientist as superior to ordinary people. Not malevolent but not harmless; even though his inventions are genius and revolutionary, they have disastrous consequences.
The inhuman researcher	Can be based on real, modern people with scientific credibility who work with science, society, and relationships. However, they are robotic, non-human, and obsessive, unable to have lasting relationships, and portrayed with different levels of understanding and empathy.
The scientist as adventurer	Active and working in the field, he is involved in activities that extend beyond science. An inventor, researcher, and traveler who transcends the limitations of the physical world, he solves mysteries, and bravely and strongly faces adversity with optimism and reverence for scientific knowledge.
The noble scientist, as a hero or savior of society	Seen as an essential ally in remediating nature and defending social causes; he invents new methods and technologies to save the lives of downtrodden families. This selfless, well-intentioned scientist is often presented as a warrior in environmental struggles, educating society about the dangers perpetrated on the planet and its creatures.

Source: adapted from Haynes (jul. 2003).

Table 4: Classic stereotypes of women scientists, as identified by Flicker

The old maid	Female character who always seems to lack a balance between professional life and love; the more professionally competent she is, the less attractive. As this character undergoes a physical transformation, her professional skills gradually diminish until they are entirely ignored.
The male woman	An assertive, tough woman with male behavioral traits, especially bad habits (unhealthy sleep patterns, smoking, drinking, taking pills, and other addictions associated with masculinity). Professionally, no matter how good she is she is not depicted as superior to male characters, and has no feminine charms or sex appeal. The feminine values attributed to this character are intuition and emotional connections in relation to scientific themes.
The naive expert	A young, good-looking woman with a promising scientific career. But her innocence, naivete, and feminine emotions are characterized as weaknesses, and this character always ends up in complicated situations where only one male character can save her.
The evil plotter	A young and attractive character, but with a dark, selfish, and unscrupulous hidden side. The polar opposite of the innocent expert.
The daughter or assistant	Always in an unequal relationship with a more experienced or more important male partner. The male partner is the main star and is the central role in the plot; the female character is there only to offer assistance in "minor" matters. No matter how good the scientific qualifications of this character, she is subordinated and acts as a bridge between complex science and society.
The lonely heroine	She is recognized as a competent scientist in her area, and adopts aspects of the male inhuman researcher, since her life is entirely based on and defined by her professional career and scientific research. She has no family responsibilities (even if she has a family, work is more important), and is completely unconcerned with emotional and esthetic issues generally considered feminine. She is not an "old lady" or "male woman" in terms of appearance (she is young, attractive, modern, self-sufficient, and scientifically capable), but is still presented as having a disadvantage compared to male characters.

Source: adapted from Flicker (2003).

Representations of science – scientific fields and practices represented in films

In this area of the analysis, we identified the scientific fields and practices present in the film scenes, along with the terms and symbols used. The goal was to answer the following questions: Does this production explain any scientific concept or term? Does it address controversies (scientific or otherwise)? Does it mention concrete benefits of science? Promises of science? Concrete damage from science? Potential risks from science? Does it make recommendations to viewers? Does it offer context information? Does it present science as a collective, individual, or corporate activity?

Narrative – mixing images and texts to create meanings

The film narrative process, according to Mikos (2014, p.4), "consists of causally weaving situations, actors, and activities into a story, whereas dramaturgy is the way this story is constructed appropriately to the medium." This part of the analysis explores how the story is told, focusing on the interactions between scenarios, situations, and characters' activities.

The topics shown in Table 2 were used to understand the representations of science in the narratives, since these indicators configure the characteristics and esthetics of how the scenarios are composed. To analyze how the representations of the scientists were

constructed, we used the classic stereotypes described in Tables 3 and 4, since directors and actors must quickly pass on visual information along with speech, actions, and facial expressions to develop a cinematographic narrative (Mikos, 2014).

The cinematic anatomy of the Emerald Giant

We found that representations of male scientists were more frequent than women scientists in the four films, with ten male scientists depicting four stereotypes: the mad scientist, the helpless scientist, the foolish scientist and the noble scientist. Four women scientists appeared, representing three stereotypes: the old maid, the naive expert, and the daughter/assistant.

Table 5:: Representations of scientists in the four films

	Representation of scientists							
	Man				Woman			
Film release year	1977	1978	2003	2008	1977	1978	2003	2008
Number of scientists	3	2	3	2	1*	1	1*	1*
Number of classic stereotypes (Haynes, jul. 2003; Flicker, 2003)	4				3			

* Repetition of the same stereotype (daughter/assistant) in different films and times.

Source: prepared by the authors.

Even though few scientists were portrayed, they reiterated the stereotype of scientists as middle-aged white men and younger white women. There were more of the classic stereotypes (Haynes, jul. 2003; Flicker, 2003) among the male characters, while three of the four women scientists have characteristics of the scientist as a daughter or assistant. Despite the changes that occurred in the 25 years between the films, in our corpus of superhero adventures women scientists were still presented as characters that support and emotionally complement the male characters.

In the 1977 and 1978 films, the central character, a male scientist, corresponds with the stereotypes often used in films analyzed by Haynes (jul. 2003, 2006, jun. 2014) from 1951 to 1976. Dr. David Banner, the protagonist in both films, is a renowned researcher, famous in his area of work and employed by an institution. He also has characteristics of the helpless scientist who is the victim of his own discoveries, constantly on the run and hiding from society to find a solution for his own (negative) creations. Banner also shows signs of the mad scientist, obsessed and even experimenting on himself in secret without considering the consequences.

Two stereotypes of women scientists appear in these two films from the 1970s. In the first, Dr. Elaina Marks is portrayed as the assistant, which Flicker (2003) notes was frequent in films from 1951 to 1976. In the second film, throughout the narrative Dr. Carolyn Fields is portrayed as an old maid, which according to same author was frequent from the 1930s to 1950. The two scientists have traces of the naive expert, a stereotype associated with representations of female scientists in the 1980s. Both are attractive with promising

scientific careers; their feminine emotions get them into tricky situations where only the male character can save them.

The characters (of both genders) have careers, renown, and assignments linked to institutionalization and professionalization in their areas of research. Beyond scientific laboratories and experiments, the narratives dramatize the social functions of these scientists: they talk to ordinary people, live normal lives, suffer from the everyday grind.

The narratives of the two films follow the same premise: scientists looking to solve specific problems. These characters are generally portrayed as professionals working in an institution; they conduct research linked to an employer. They have access to teams, well-equipped laboratories, and financial resources that allow them to exercise their scientific abilities in work that benefits society.

In the 2003 and 2008 films, the characters exhibit multiple stereotypes and characteristics, in line with Haynes's studies (2014). This researcher states that even as new stereotypes of scientists emerge in movies, the mad scientist remains in the imagination of society. But starting in the 1990s, they are not considered the main threats or symbols of disaster.

David Banner, Bruce Banner's father and the evil scientist in the film, is not classified as a threat to society, and does not cause widespread panic. His only goal after being released from prison is to continue his scientific research in search of power, overcoming normal human limits in his quest to attain the *Übermensch* (Nietzsche, 2012). Banner does not seek to destroy society, cause disasters, or carry out terrorist acts.

In the 2003 film, we can see what Irwin (2009) calls the double power principle, when science and scientists can be good or bad, depending on the intentions, uses, and results of their discoveries. The scientific representations in these films are on opposite sides: some are considered good scientists/heroes (Bruce Banner, Beth Ross, and Harper) and others bad scientists/villains (David Banner and Glenn Talbot).

The 2008 film has the same narrative and emphasizes the fight against threats to US national security, and also uses the armed forces as instruments for regulating and monitoring science. But while attempting to study, contain, and use the Hulk's DNA, the military and scientists create a monster that poses an even greater threat, the Abomination.

This film shows what Weingart, Muhl, Pansegrau (2003), and Turney (2005) classify as the danger of ambivalences in science: the greater the scientific and technological advances, the more concern about potential side effects from these discoveries.

The 2003 and 2008 productions feature significant action and adventure, and stories about hierarchy issues and power disputes between scientists, private institutions, and the military to dominate scientific practices. The military intermediates between the government and the scientists, presenting the public with an image that the armed forces are always ready to confront and control threats derived from neglect on the part of the scientists.

Both directors take advantage of the social climate to address the possibilities of the scientists' work in their laboratories, and use uncompromised entertainment to talk about biotechnology with all types of viewers.

The scientific areas addressed in films 1 and 2 are biology (with an emphasis on basic issues related to genetics, genetic sequencing, and mitochondrial function), nuclear physics (with gamma radioactivity leading to DNA mutations), and neuroscience (as a possible therapy for psychological problems).

These three areas were present in the scientific community in the 1970s. Viana and Reblin (2011) note that American society at that time lived in fear of the products of science and technology. These fears were related to eugenic medicine, nuclear physics, and the science used in the military clashes of the Cold War.

Even without showing war scenes, the films dramatize the psychological effects of the successive Cold War conflicts: nightmares, trauma, guilt, anguish, and melancholy, addressing social and cultural issues of the time when they were made. The Vietnam War (1955-1975) produced many soldiers who were psychologically unable to adapt to civilian life after returning from the battlefield. And during the 1960s and 1970s, discussions of mental health and the social and human sciences progressed in the US, motivated by university expansion. An example is the Free Speech Movement that took place at the University of California, Berkeley in 1964 (in film 3, Bruce Banner, Betty Ross, and Harper are researchers at this institution); these protests were rooted in the civil rights movement and the growth of student, social, and artistic fronts, especially the hippie movement.

Counterculture activities were organized by young people who were tired of following rules they had not made but were required to follow. The movements questioned patterns of social behavior, religion, sex, social institutions (family, church, marriage, educational system, government, police, army, and private corporations) and esthetic standards. All this turmoil among the youth produced a peaceful anti-war revolution, symbolized by Martin Luther King Jr., the hippie movement, and Woodstock.

In film 3, the scientific areas represented are cell biology and genetic engineering, both linked to the development of the Human Genome Project (Gallian, 2005); this initiative was created in 1990 by the US Department of Energy to sequence all the DNA in the human genome and create a database to improve molecular study techniques, and affected biomedical research, specifically biological and clinical medicine studies. Molecular medicine extends deeper into the root causes of disease, using rapid and specific diagnostic tests for early treatment of various diseases.

Expressing the expectations of that time, the film shows scientists who search for a cure for disease and injuries via nanotools, genetic manipulation, and gamma radiation. In the film, the researchers manipulate the immune system to create beings capable of accelerated cell regeneration, as seen in the prologue when Dr. David Banner is conducting animal research, and during the main narrative as Bruce Banner, Beth Ross, and Harper conduct research on frogs.

In the 1990s and early 2000s, the media reported cases such as planting and marketing of genetically modified organisms (GMOs), animal cloning (the case of Dolly the sheep, the first cloned mammal, was widely publicized), and the use of nanotechnology in environmental cleanup, leading to discussions among scientists, governments and society. In other words, the narrative in film 3 uses a 1960s superhero together with scientific issues

present in the real-life media to tell a story blending action, science fiction and adventure in terms familiar to twenty-first-century audiences.

Ang Lee, a Taiwanese filmmaker, producer, and screenwriter based in the US and the director of film 3, is known for his critiques of American society. In *Hulk*, the director presented two critiques of society involving ethics and human nature (Barkman, 2013; Dale, Foy, 2013) and the search for power via the military industry (Zietsma, 2013). The former is conveyed in the clashes between the scientists' ideologies and positions. In this film, Dr. Banner-Krensler and Dr. Ross symbolize the safe, controlled, ethical and rigorous side of science, demonstrating scientific work in laboratories, following protocols, undergoing evaluation by committees, and publicly presenting procedures and results. They are professionals who accept and act in accordance with the regulations and conditions for practicing science imposed by governments and institutions. These scientists, who are considered good/heroic, follow the three dimensions of public science communication described by Durant (2005): scientific knowledge, scientific techniques and the safe practice of scientific culture, for progress and the well-being of society.

On the other hand, Dr. Banner represents the stereotypical scientist portrayed in films between the 1930s and 1950s: he is the mad scientist who pursues his alchemy without respecting rules, laws, or orders from superiors, secretly and unwisely. He argues that scientists should be free to use their skills and genius to control and overcome the laws of nature in the quest for power. He triggers all the accidents caused by science in the film: tests on humans and animals, forbidden experiments on the immune system, the gamma radioactivity explosion, the accident in the Berkeley Institute laboratory that produces the Hulk creature, the creation of mutant dogs, and also the villain Absorbing Man.

Lee also critiques the military industrial complex, represented in the film by soldiers and the Atheon company. Both want to control nanotechnology research and plan to capture the Hulk to use his modified DNA for military purposes, developing weapons and generating financial profits. The character Glen Talbot describes his work as "bad science." And General Ross, upon discovering Bruce Krensler-Banner's true identity, confiscates all the scientist's research material and classifies it top secret for national security.

Film 4 has less reflective dialog containing warnings, critiques, or advice about the pros and cons of scientific practices. It is an action movie with special effects and a narrative created to maintain adrenaline levels high as viewers expect explosive events in each scene. This reflects what Costa and Orrico (2016) identify as the familiarity and memory of superhero adventure audiences in the twenty-first century, because action scenes based on visual effects were trademarks of upcoming movies in the Marvel Cinematic Universe.

The areas of science presented in the film are genetic engineering, cell biology, use of gamma radiation, use of vita rays,[1] computer science, and computerization of research. In one of the scenes, we can see the transformation and advancement of the equipment used in these areas when Dr. Bruce Banner sees his laboratory as it was before his first transformation into the Hulk and the current state of the lab after his years of exile. This is the use of virtual witnessing technology described by Kirby (2014). Even in a 112-minute movie, Banner's memories (which last just over a minute) provide plausibility for the

passage of time in the film. The public understands that years have passed since his first transformation into Hulk and Banner's escape into exile.

During the 25 years between the films produced in the late 1970s and those launched in the 2000s, major social, cultural and technological changes took place. Technological transformations have had the greatest impact on how films are produced, since as Kirby (2014) points out, virtual witnessing technologies have reduced the distance between what happens in real laboratories and in films.

This decreased distance between real events and fiction can be seen according to what Kirby (2014) calls the plausibility offered by new virtual witnessing technologies. The scenes in which Banner transforms into the Hulk show how much virtual technologies have advanced. In the 1977 and 1978 films there were few Hulk scenes, since they involved two actors along with heavy makeup, camera tricks and overlaid images. Even then, it was still hard to believe that Bill Bixby had transformed into the green-painted Lou Ferrigno. In the 2003 and 2008 films, computer graphics, new film techniques and virtual montage made Eric Bana and Edward Norton's transitions more credible.

Films 1 and 2 are shorter than 3 and 4, but the cultural meaning of the scientists in the narratives are equivalent, as we can see in Table 2.

Table 6: Overview of the presence of scientists in the four films

	Overview of the presence of scientists in the four films			
	Film running time (minutes)	Presence of scientists (minutes)	Presence of scientists (percent)	Presence of scientists (numbers)
Movie 1	94	86	91	4
Movie 2	97	92	94	3
Movie 3	138	101	73	4
Movie 4	112	82	73	3
Total	441	361	82	14

Source: prepared by the authors.

This decrease in the percentual presence of scientists is part of the complexity of the many starting points for analyzing the films, according to Mikos (2014). This is because in the productions where the characters are the focus of the narrative, the audience has more time to get to know, understand and create emotional bonds with the characters onscreen.

By adapting The Incredible Hulk for the audiovisual milieu, director Kenneth Johnson discarded elements of the comic books and reformulated the story and characters for the models of popular dramaturgy in the 1960s and 1970s. Johnson's goal was to reach audiences who watched television and went to the movies, without coming up against the stereotypes linked to comic books. He decided to go use the formula for soap operas, with drama, romance and interpersonal relationships to tell the story of how the Hulk came about (Jankienwickz, 2013).

Meanwhile, Ang Lee and Louis Leterrier, who directed the 2003 and 2008 films, respectively, approached their productions in a manner that was more faithful to the themes in the comic books: action, adventure, science fiction and social criticism. Before

these two films were released, a major player in the comic book market filed for bankruptcy protection in 1996, but reemerged on September 11, 2001 with the attacks on the Twin Towers (Robb, 2017).

Lee and Leterrier returned to the comic book narrative of the 1960s, with the story of the Hulk created by a scientific accident caused by an internal threat on American soil. The directors used the stories from the 1970s, when science belonged to the government, not to scientists, as well as narratives in the 1980s comic books, when the focus was on the psychological crises of the Banner/Hulk duo and the constant persecution by the military.

In films 1 and 2, the scientist characters are introduced, their stories develop linearly during the entire production, and all the contextualization takes place around them. There are no secondary stories as the narratives unfold; the film centers on the scientist characters, and each scene takes place after the previous one. In film 3, the scientists are presented in a linear manner during the first thirty minutes, but then are involved with other events unrelated to science work and become part of the main action in the film.

Unlike the others, film 4 is part of a narrative rooted in convergence culture and the transmedia experience (Jenkins, 2006; Costa, Orrico, 2016), adding elements from other movies (*Iron Man* and *Captain America*) and references to previous productions of The Incredible Hulk. At the same time, it tells the story of the Hulk's origins, and introduces details of the genetic manipulation in the military's supersoldier project and the role of Stark Industries in science within the Marvel universe.

The scientific issues addressed in the four narratives interrelate with each other, and from one perspective tell the story of how biogenetic research evolved alongside a famous case in the real world. The British scientist Stephen Hawking, who became famous for his work in theoretical physics, was diagnosed with amyotrophic lateral sclerosis (also known as Lou Gehrig's disease) in 1963; he lived with the disease for more than fifty years, and when he died in 2018 no cure had been found.

In film 1, the narrative explores DNA manipulation to unleash the physical potential used by humans during moments when adrenaline runs high. Genetic sequencing and mitochondrial studies are highlighted in dialogs between the scientist characters.

During film 2, Dr. Fields is diagnosed with a disease similar to Stephen Hawking's and dies in short order before Dr. Banner can find a cure. Again, the study of mitochondrial function is prominent in the scientists' work.

In film 3, genetic manipulation research is highlighted again. The prologue introduces the studies conducted in the 1960s and then moves to the use of nanomaterials to potentially cure diseases and injuries at the cellular level.

In the last film, Dr. Stern states that his research on the blood contaminated by Banner's gamma radiation was making progress to heal people and make them immune to disease.

Also in film 4, the Hulk and the villain, the Abomination, are both results of genetic manipulation. Banner and Professor Ross began their work at an university research institution under the direct supervision of the military. The Hulk is created when this research goes out of control and the military pursue him with private support. The military's goals are to study and use his modified DNA to manufacture improved soldiers.

But this pursuit is not restricted to the physical world: it expands with advances in virtual data processing technology. The Internet evolved exponentially between 2000 and 2008, becoming part of everyday social life. Allgaier (2016) points out that the launch of the YouTube platform in 2005 expanded the interaction and distribution of information in virtual communities, which provided visibility and facilitated the spread of the subjects present in movies through trailers, marketing, reviews by experts and fans, and video analytics.

Communication technology for virtual networks is represented by the mention of S.H.I.E.L.D., a secret agency that uses computer science to track confidential messages exchanged between Banner and Stern (in which they use the pseudonyms Mr. Green and Mr. Blue, respectively). And it is thanks to Dr. Stern's secret experiments that the Abomination is created: an out-of-control creature capable of causing destruction and death on a large scale.

The opportunity for more communication does not always provide beneficial results. According to Allgaier (2016), the Internet provided fertile ground for scientific facts to be discussed and popularized. However, conspiracy theories, fake news, and poor-quality scientific studies began to have an impact that approached or even eclipsed specialist discourse in the socio-cultural sphere.

Before the final confrontation between the Hulk and the Abomination, Bruce Banner addresses the secret communications and lack of trust between them: Doctor Ross, the military, Doctor Stern, and himself were all responsible for producing both the hero and the villain of the story through misusing science. And the question of distrust and secrecy among scientists will be present in other films in the Marvel universe, creating superheroes like Iron Man and Captain America as well as villains like the cyberthreat Ultron. However, these are subjects for future studies.

Final considerations

Studies by Andrew Tudor (1989), Roslynn Haynes (1994, jul. 2003, 2006, jun. 2014), Eva Flicker (2003), David Kirby (mar. 2003, 2003, 2011, 2014), and other experts have shown that elements in films have referred to science and scientists over more than one hundred years of production in this industry. This includes old and modern films, low-budget as well as large-scale Hollywood productions, with and without special effects.

In our study, the scientist characters and science are important in the stories of the Banner/Hulk duo. In fact, scientific elements are present in all four analyzed films and scientific practices are the main context for the narratives, in the movies that were more 1970s-style romantic dramas as well as the action films of the 2000s. The scientific issues varied according to the two different eras, however, expressing some topics that were notable at these times.

In the 1970s, the narratives discussed DNA and mitochondria, as well as diseases like amyotrophic lateral sclerosis. Meanwhile, the storylines in the films from the 2000s refer to genetic manipulation and the use of regenerative practices similar to stem cell research. The scientific themes addressed in the four movies interconnect to tell the story of how biogenetic research evolved, as in the example of Lou Gehrig's disease and Stephen Hawking.

Representations of male scientists were found to be more recurrent than women scientists. The four films combined contained ten male scientists representing four stereotypes (the mad scientist, the helpless scientist, the foolish scientist, and the noble scientist), while four women scientists are also presented, depicting three stereotypes: the old maid, the naive expert, and the daughter/assistant.

Although the number of scientists is small, we note that in general, the most common representation of scientists in the Hulk films (even in the newer productions) is another comic book stereotype: middle-aged white men. Three of the four women scientists are depicted as a daughter or assistant. Despite the 25 years between the films in our corpus of superhero adventures, women scientists were still presented as supporting characters that emotionally complement the male characters.

There are signs of change in this gender imbalance in other recent superhero-based films where female characters are starting to play leading roles, most notably the scientists Dr. Isabel Maru, in *Wonder Woman* (2017), Princess Shuri of the Kingdom of Wakanda in *Black Panther* (2018), and Drs. Wendy Lawson, Marie Rambeau, and Minerva in *Captain Marvel* (2019), but these are films for future studies.

We also observed changes in how the narratives were constructed. The 1977 and 1978 films utilize one dramatic structure, the scientist characters are introduced, their stories develop in a linear manner during the entire narrative, and the context takes place around them. The latter films are action films.

The elements of science also are articulated differently, but this is not necessarily linked to the time period. In the 1977 and 1978 feature films, science is an intrinsic part of the narrative. In the 2003 movie, the scientists are presented in a linear manner during the first thirty minutes, until they are involved with other non-scientific events and become part of the main action in the film. But the 2008 film tells the story of the Hulk's origins, introduces details of genetic manipulation in the military's supersoldier project, and exposes the role of Stark Industries in science in the Marvel universe.

Film analysis is not a simple task. Analytical tools must be prepared, selected, and defined carefully, in accordance with the material to be studied and the methods to be used in order to avoid pitfalls involving seeing what we want to see rather than analyzing what the data reveals. One of the challenges of this study was the constant need to watch and rewatch the films numerous times, paying attention to every little detail: the action of a character, camera tricks, scene changes, narrative flow, contextual information, scenario data, continuities and discontinuities. Finally, tools were needed that could reliably validate reproducible results, with the confidence to separate research from entertainment.

This study discussed representations of science and scientists in the narratives of the four Hulk films. A question for future studies would be: How are these representations perceived by the various (and growing) audiences that watch these movies?

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NOTE

[1] Vita radiation (or vita-rays) is an element of Marvel Comics' fictional scientific culture. This electromagnetic radiation was used to activate the Super Soldier Serum, and was created by the scientist Abraham Erskine (Captain America..., 1940).

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