A JOURNAL BY SISSA MEDIALAB

ARTICLE

Science on screen: the representation of science in independent films

Edite Felgueiras and Teresa Ruão

Abstract

Cinema has long been a powerful medium for exploring and communicating scientific ideas. From its early days, film has served as both a tool for scientific documentation and a means of engaging the public with scientific concepts. While mainstream films have popularised scientific issues, independent cinema, distinct from Hollywood's commercial focus, offers more innovative and critical portrayals of science. By examining short films from the 2023 Braga Science Film Fest, this study investigates how independent films represent science and scientists. The findings reveal that while these films often depict scientists as adult white men, they challenge traditional stereotypes by avoiding common scientific tropes, like the mad scientist, and instead portray a more diverse range of scientific endeavours and behaviours, contributing to a nuanced understanding of science in society.

Keywords

Representations of science and technology; Science and technology, art and literature; Science communication: theory and models

Received: 20th September 2024
Accepted: 5th March 2025
Published: 14th May 2025

1 ▪ Introduction

Cinema provides a powerful platform for exploring and communicating scientific ideas, engaging audiences with both factual and fictional representations of science. This unique ability of the medium to blend reality with imagination has allowed it to shape public perceptions of science throughout its history. From early depictions of scientific discoveries to the creation of science fiction, as seen in Georges Méliès' *A Trip to the Moon* (1902) and Émile Cohl's *Fantasmagorie* (1908), cinema has played a crucial role in both documenting and imagining scientific possibilities [Merzagora, 2010]. In fact, cinema's role in science extends far beyond the mere representation of factual events; it has also been instrumental in shaping speculative futures, presenting fictional visions of science that challenge or complement our understanding of reality. This dual function — documenting reality while simultaneously imagining new possibilities — has been central to the evolution of cinema as a medium for science communication [Kirby, 2008].

This historical foundation in scientific documentation and speculation laid the groundwork for cinema's continued influence on how science is communicated to the public. Even before the Lumière brothers burst onto the Parisian artistic scene in 1895 with the first public cinematic screening, the projection of moving images was already serving scientific purposes — films such as Eadweard Muybridge's motion studies laid the groundwork for the use of film in scientific observation [Kirby & Ockert, 2021; Canales, 2011], and since then, cinema has acted as a bridge between the scientific community and the public, capable of sparking interest and encouraging reflection on the role of science in society. Similarly, documentaries like *An Inconvenient Truth* (2006), by former U.S. Vice President Al Gore, which addresses climate change, or biopics like *The Theory of Everything* (2014), about the life of theoretical physicist Stephen Hawking, have helped popularise scientific concepts, making science accessible and comprehensible to a lay audience.

On the other hand, cinema can also serve as a mirror of society, prompting reflection on ethical concerns and issues surrounding scientific progress. *Gattaca* (1997) and *Ex Machina* (2014) explore these issues in the contexts of genetic research and artificial intelligence, stimulating important debates about the limits of science and technology.

The studies of Tudor [1989], Weingart et al. [2003], and Haynes [2016] have observed this influence of cinema in shaping the collective imagination about science. However, the focus of these analyses has largely been on fiction films from Hollywood, the "mecca" of cinema, often overlooking the broader cinematic landscape, including films from independent cinema. While Hollywood has undeniably shaped public perceptions of science, largely through mainstream genres, research from the past decade has expanded this focus to include a more nuanced view of science in film. Scholars like David Kirby [2007] have explored how Hollywood, despite its commercial nature, still plays a pivotal role in constructing narratives about science, often framing scientists as heroes or villains, which influences how the public engages with scientific issues. Kirby's work highlights that mainstream cinema not only entertains but also reinforces cultural stereotypes and societal views on science and its practitioners.

In contrast, independent cinema has opened up space for more varied and critical portrayals of science. Independent films are more likely to challenge conventional narratives and offer alternative visions, often exploring complex scientific themes and subverting traditional

stereotypes [Levy, 1999]. These films, free from the commercial constraints of Hollywood, contribute to a more diverse conversation about science, engaging audiences not only in entertainment but in discussions about the social and cultural implications of scientific progress. Recent studies, such as Soucy-Humphreys et al. [2023], have further emphasized the role of media outside the mainstream in challenging traditional portrayals of science. The authors argue that independent cinema subvert stereotypes about gender and science, opening up space for more inclusive and diverse representations. These works play a crucial role in shaping audiences' perceptions of who can be a scientist, suggesting that independent cinema can be an important counterforce to the often reductive portrayals found in commercial media.

Given this, when exploring the relationship between cinema and science, one cannot ignore the significant role that independent cinema plays in shaping the collective imagination about science. By embracing the multiplicity of voices and stories found in independent films, we gain a more comprehensive and enriching understanding of the intersection between science, culture, and society.

In this article, we analyse how independent cinema has portrayed complex scientific concepts, scientists, and the scientific process in general, starting with the research question: "How is science represented in independent short films?" The analysis seeks to identify the most represented scientific themes and fields of research, as well as to understand how scientific concepts have been presented in cinematic narratives. The study also aims to understand how these representations of science reflect or perpetuate stereotypes.

We live in an era where science plays an increasingly active role in society, with the potential to change it economically, politically, and culturally. In this context, understanding how science is portrayed in cinema is essential to combating misinformation and fostering debate on ethical and social issues. From a scientific point of view, the study aims to open doors to a deeper and more contextualised understanding of the role of independent cinema in the communication of science.

2 ▪ Literature review

2.1 ▪ *The intersection of science and cinema*

The first commercial film screening is historically recorded as taking place in 1895 at the Grand Café in Paris, France, under the direction of the Lumière brothers [Carvalho, 2022]. However, even before the brothers from Lyon burst into the Parisian artistic scene with their cinematograph, the projection of moving images from sequences of photographs was already serving scientific purposes. It was through the research of photographer Eadweard Muybridge and physiologist Étienne-Jules Marey, who studied animal movement, that chronophotography emerged in the late 19th century as a technology for capturing motion [Kirby & Ockert, 2021; Canales, 2011].

Scientists from various disciplines utilised this technology, with film becoming a medium for recording and analysing both macro and microscopic experiments [Canales, 2011]. Some of these experiments were even presented at the French Academy of Sciences in the late 1880s [Oliveira, 2006].

During this period, it was unclear whether cinema would remain a scientific tool for documenting and studying reality, or if it would make the leap to pure entertainment. Ironically, it was a fictional scientist who largely determined the fate of cinema: Professor Barbenfouillis, leader of the scientific expedition to the moon in *A Trip to the Moon* (1902) by Georges Méliès. Inspired by Jules Verne's *From the Earth to the Moon*, the film's success in both Europe and the United States influenced investors to finance the birth of the film industry [Merzagora, 2010].

During Hollywood's golden age in the 1930s and 1940s, science was often romanticised and incorporated into science fiction and adventure films. But in the 1950s, in the aftermath of the Second World War, the relationship between science and cinema, filmmakers and scientists, changed, evolving towards greater professionalism [Gregory & Miller, 1998]. After 1945, science assumed a central role in society, moving towards industrialisation and the implementation of practices regulated by intellectual property and confidentiality. The 1960s brought a division of responsibilities: scientists produced the facts and filmmakers used them to create audiovisual content suitable for the general public. This situation created tensions within the scientific community, divided between those who saw audiovisual media as a promise of universal education and those who feared that entertainment would compromise authenticity [Vidal, 2018].

However, the growing collaboration between filmmakers and scientists, as seen in the last decades in films like *Interstellar* (2014), demonstrates that cinema can be an effective tool for disseminating scientific knowledge [Weingart, 2005, cited in Vidal, 2018].

Cinema has also proven to be a valuable resource in scientific education, helping to bridge the gap between theory and practice and motivating students to learn science in ways that traditional methods cannot achieve [Dubeck et al., 1993, cited in Koehler et al., 2013]. Fiction in cinema has played a role in raising awareness of social issues and influencing behaviours, as seen in public health films and, more recently, in *Contagion* (2011), which served to contextualise responses to the COVID-19 pandemic [Rogers, 2020; Lewis, 2020].

The use of cinema to promote science goes beyond mere transmission; it transforms the audience into active participants in the legitimisation of scientific knowledge by involving them as witnesses in the creation of that knowledge [Shapin & Schaffer, 1985; Gouyon, 2016]. However, studies on the impact of cinema on public perception of science are still limited, making it difficult to precisely determine how films influence public attitudes. Audience interpretations vary according to social context, complicating the analysis of films' impact on scientific perception [Kirby & Ockert, 2021].

2.2 ▪ Science in cinematic narrative

The portrayal of science and technology in cinema is a powerful means of shaping public opinion and making science more accessible and appealing. Susheela Varghese and Sunita Abraham [2004] highlight that popular representations of science often diverge from academic conventions to be more accessible, employing strategies such as metaphors and humour [Giannoni, 2008].

Cinematic narratives frequently reflect societal fears about science, particularly in popular fiction films. Kirby and Ockert [2021] identify an evolution in the depiction of science in

cinema over the decades, noting how different disciplines gained prominence at specific historical moments. For example, endocrinology was prominent in the 1920s, driven by controversial experiments, and psychology became significant in the 1940s, reflecting behavioural concerns in the United States [Weingart et al., 2003].

Nuclear science and space science dominated cinema in the 1950s and 1960s, influenced by the post-war context and the space race, respectively. Kirby and Ockert [2021] explain that, despite the utopian view of scientific progress, cinema also explored the duality of science as a force for both good and evil, as evidenced in films like *Them!* (1954). In the 1970s, environmental concerns became a central theme, with films addressing issues such as ecological disasters and overpopulation [Kirby & Ockert, 2021].

Biomedical sciences and genetics emerged as dominant themes in the 1990s and 2000s, with films like *Jurassic Park* (1993) and *Gattaca* (1997) generating significant discussions on bioethics and genetic manipulation [Kirby, 2007]. Nanotechnology also became a relevant field for creating science fiction narratives, with films exploring its dangerous implications.

From 2010 onwards, space exploration returned to cinema with a more authentic approach focused on the human and scientific experience, as seen in *Gravity* (2013) [Kirby & Ockert, 2021].

Over these decades, cinema has also presented a wide range of characters connected to science, from visionary heroes to more stereotypical figures. In her study on the portrayal of scientists in literature and cinema, Haynes [1994] identified six recurring stereotypes: (1) the alchemist/mad scientist; (2) the absent-minded professor; (3) the inhuman rationalist; (4) the heroic adventurer; (5) the impotent scientist; (6) the social idealist. Weingart et al. [2003] expanded on these profiles, noting in their study of 222 films across various genres, produced over 80 years, that scientists are depicted as white/Caucasian, North American, male, and middle-aged. The youth cult, so common in other film genres, is not reflected in the portrayals of scientists.

Weingart et al. [2003] acknowledge that science is traditionally a very male-dominated field, where women have had little place or occupy a 'woman's place'. Given this, it is unsurprising that less than a fifth of the characters portrayed in the films they analysed are women. More relevantly, the study revealed that female scientists are depicted as younger and more attractive than their male counterparts, usually occupying lower positions in the professional hierarchy. Eva Flicker [2003] recorded similar findings. In her analysis of 60 films produced between 1929 and 1997, she found a predominance of male scientists and noted that the typical portrayal of female scientists fits the stereotype of a teacher with specific physical attributes: young, beautiful, athletic, and dressed provocatively. Through a sociological interpretation of the films, Flicker identified six stereotypical portrayals of female scientists: (1) the spinster; (2) the masculinised woman; (3) the naïve expert; (4) the evil plotter; (5) the daughter or assistant; (6) the lonely heroine. Flicker argues that these portrayals significantly contribute to the development of myths about the incompetence of female scientists, reinforcing social discrimination against women in science.

Expanding on previous studies, Steinke [2005] analysed 74 Hollywood films produced during the 1990s and found that 33 per cent included female characters in the roles of scientists and engineers. In contrast to earlier representations, these female scientists are depicted in a more realistic manner and often escape traditional gender stereotypes.

Building upon this, a study by Kool et al. [2022] examined the portrayal of women scientists in films within the context of fourth-wave feminism. The research highlights that while there has been progress in depicting female scientists more realistically, challenges remain in fully breaking away from traditional gender stereotypes.

Furthermore, a chapter by Chambers [2022] discusses the representation of women in STEM (Science, Technology, Engineering, and Mathematics) fields in contemporary film and television. The authors argue that with a more intersectional approach to the representation of the sciences on screen, it may be possible to begin shifting the expectations of what science is, and who scientists are and what they look like.

The complexity of these figures in cinema continues to fuel dramatic narratives, with the increasing representation of women in science reflecting a growing recognition of their role in shaping the future. However, as authors like Merzagora [2010] argue, these stereotypes persist, even in a society that increasingly relies on science to solve global problems.

2.3 ▪ *Beyond Hollywood: science in independent cinema*

Independent cinema, according to Sherry Ortner [2012], can be seen as the antithesis of Hollywood films, characterised by lower budgets, challenging themes, and realism, whereas Hollywood productions tend to focus on large-scale entertainment and happy endings. Emanuel Levy [1999] adds that independent cinema reflects the personal vision of filmmakers, often with an idiosyncratic and critical approach. However, over time, particularly in the 1990s, major studios began to finance independent films, leading to their integration into more conventional norms.

Despite this integration, Levy [1999] highlights that it is still possible to identify independent films by their funding outside of Hollywood or by the innovative vision of their creators. Filmmakers like the Coen brothers, even when working with major studios, are considered essentially independent due to their creative approach. This alternative vision, however, maintains an antagonistic relationship with the mainstream audience, which expects to be entertained without deep reflection. Many indie filmmakers prefer to produce films that appeal to specific niches rather than seeking broad commercial success [Hope, 2010].

Levy [1999] suggests that independent cinema, although not formalised as a movement, has always been committed to a countercultural vision, authentically reflecting contemporary society. These films aim to portray reality with depth and honesty, even if it causes discomfort to the audience. Furthermore, analysing these films requires an understanding of various codes, such as cultural, artistic, narrative, cinematic, and intertextual, which shape their unique narratives and styles.

However, there is currently criticism regarding the commercialisation of independent cinema, which is often used as a marketing tool, as exemplified by the film *The English Patient* (1996). Levy [1999] notes that despite technological and market changes, indie cinema is no longer as experimental as it once was and is increasingly embedded in the conventional commercial circuit.

The growth of independent cinema in the 1990s also brought recognition and easier access to funding, with filmmakers securing support from both American and European investors [Levy, 1999]. Digitalisation and the advent of streaming have transformed film distribution,

allowing independent filmmakers to reach wider audiences without intermediaries. This has fuelled interest in diverse content, including scientific themes, as demonstrated by initiatives from foundations that support the production of films exploring the intersection between cinema and science [Vidal, 2018].

Building on this evolution, recent studies have further highlighted the significant role of independent cinema in challenging traditional representations of science. For example, Soucy-Humphreys et al. [2023] argue that independent cinema can subvert stereotypes about gender and science, opening up space for more inclusive and diverse representations. These works play a crucial role in shaping audiences' perceptions of who can be a scientist, suggesting that independent cinema can be an important counterforce to the often-reductive portrayals found in commercial media.

Moreover, other scholars, such as Anita Simis [2018], have highlighted the evolution of independent cinema, focusing on the role it plays in building a more authentic connection to contemporary societal issues. Simis argues that the independence of a film is no longer defined purely by its budget or funding, but also by its ability to present an artistic vision that remains distinct from commercial imperatives. This shift has enabled independent cinema to become a space for exploring a broader range of scientific themes, allowing filmmakers to challenge stereotypes and engage in more profound social and cultural discussions.

3 ▪ Method

Tudor [1989], Weingart et al. [2003], and Haynes [2016] have demonstrated that cinema influences our perception of science. As noted by these authors, the way science is portrayed on screen can impact public understanding of scientific concepts, shape perceptions, and raise questions about technological advancements. Understanding this representation enables science communicators to address misconceptions, challenge stereotypes, and improve message content, fostering a more accurate, effective, and ethical understanding of science. However, these studies have focused on Hollywood blockbusters, particularly fiction films, neglecting independent cinema. Unlike commercial film productions, indie cinema offers fertile ground for less conventional approaches and narratives, which are attracting audiences tired of mass-produced cinema [Goldsmith, 2023].

Therefore, this study aims to identify representations of science specifically in indie films, with the research question: How is science represented in independent short films?

The decision to analyse only short films considers the importance of this format in independent cinema. In addition to offering greater artistic freedom to filmmakers, it is also a significant format for renewing cinematic language, as short films often serve as pilots to test new ideas (aesthetics, formats, narratives) in the market [Faria, 2015; Gebacz, 2015].

The methodology used in this study is primarily based on quantitative content analysis of the sample.

3.1 ▪ *Sample*

To understand how science is portrayed in independent cinema, this study used the short films submitted to the first edition of the Braga Science Film Fest in 2023. This international

science film festival is an initiative of the Master's in Science Communication at the University of Minho, aimed at promoting science communication through cinema in its most diverse and plural forms, valuing the inclusion of films from different nationalities, cinematic techniques, and scientific disciplines [Braga Science Film Fest, 2023a]. In its inaugural edition, the Braga Science Film Fest received 239 short films in the animation, fiction, and documentary categories from 37 countries across 6 continents. However, the festival's organisers excluded 69 films from the competition for not meeting the criteria outlined in the regulations: the short films must have a scientific character; the production date should not be earlier than 1 January 2019; entries must be under 40 minutes in length (including credits); the short films must be narrated or have subtitles in English; preliminary versions of works in progress are not accepted [Braga Science Film Fest, 2023b]. To include films in the corpus of this study, the selection criteria of the festival's organisers were adhered to, resulting in the identification of 170 short films.

Given the diverse range of genres in the festival, the films selected for this study represent a variety of approaches to portraying science, ranging from the factual and observational nature of documentary films to the imaginative and speculative approaches found in fiction and animation. It is important to note that the inclusion of these three genres in this study allows for a broader exploration of how science is represented across different cinematic forms.

The sample was subjected to quantitative content analysis based on Reznik et al.'s [2019] work on science animation short films, which itself was based on Bauer et al.'s [1995] study of quantitative content analysis of science and technology in the media. This analysis encompasses seven dimensions — general characteristics, relevance, theme, narrative, treatment, actors, and location — subdivided into various categories. Taking the short film as the unit of analysis, Reznik et al. [2019] retained, with some adaptations, the dimensions of 'general characteristics', 'theme', 'narrative', and 'treatment', and added the dimension of 'scientists' to analyse the physical attributes, stereotypes, and mythical elements associated with scientists depicted in the films. For this study, the five dimensions proposed by Reznik et al. [2019] were retained, but the categories under 'general characteristics' were revised, with the addition of the 'film genre' category to analyse fiction, animation, and documentary short films; and the categories related to identifying the festivals where the films were presented were removed, as this analysis is confined to the short films submitted to the 2023 edition of the Braga Science Film Fest (see Table 1 below).

For the category of 'knowledge domains', the 2007 Classification of Scientific and Technological Domains was used, derived from the Fields of Science and Technology list employed by the Portuguese National Statistical System [DGEEC, 2007]. For defining the age ranges to be considered, the study by Weingart et al. [2003] was referenced, which classifies young adults as scientists aged between 20 and 35 years, and adults as scientists older than this. According to Reznik et al. [2019], the categories 'scientist physical attributes' (glasses, facial hair); 'scientific research symbols' (lab coats, scientific instruments, various laboratory equipment); 'knowledge symbols' (books, notebooks, pens in pockets); 'danger indicators' (corrosive, flammable, toxic); and 'confidentiality indicators' (no entry, private) are based on the results of the DAST (Draw a Scientist Test) proposed by Chambers [1983], which asks children and young people to draw a scientist.

For the category concerning the characterisation of scientists, the attributes defined by Steinke et al. [2012] were considered:

Table 1. Dimensions and categories used to analyse the short films [adapted from Reznik et al., 2019].

General characteristics	Cinematic genre
	Title
	Director
	Year of production of film
	Nationality
	Duration
	Synopsis
Topic	Keywords
	Main area of knowledge
Scientists	Presence of the figure of the scientist
	Area of expertise
	Gender identity
	Age
	Ethnicity
	Physical attributes
	Place where scientists appear
	Symbols of research
	Symbols of knowledge
	Indications of danger
	Indications of secrecy
	Mythical and literary references
	Characteristics of scientists
	Classic stereotypes
Narrative	Narrative framing
Treatment	Does the film explain a scientific term or concept?
	Does the film address controversies (scientific or other)?
	Does the film mention any concrete benefits of science?
	Does the film mention promises of science?
	Does the film mention concrete damage caused by science?
	Does the film mention potential risks of science?
	Does the film make recommendations to the viewer?
	Does the film offer information about the context?
	Does the film present science as a collective activity?

- Intelligent: characters demonstrate intelligence when they make factual statements or offer opinions on how a particular phenomenon might have occurred, explain how a process works, use specific terminology, suggest how to proceed with an experiment, or use scientific equipment to analyse materials.
- Dominant: characters show dominance when they exert authority or influence over others (e.g., telling or showing other characters what to do).
- Lonely: a character is marked as lonely when they are the only person present in a scene and do not interact with anyone else.

- Respected: characters are considered respected when another character shows deference to them (e.g., seeks the scientist's opinion or advice, praises the scientist), or when they are awarded a prize.
- Caring: characters demonstrate care when they exhibit behaviours or make statements intended to comfort or assist others (e.g., expressing sympathy for another character's situation, offering to help another character).

In the 'mythical and literary references' category, creatures from classic works such as *Frankenstein* (1931) were considered, and in 'classic stereotypes', Haynes' [1994] work was referenced, which identifies six stereotypes: (1) the alchemist/mad scientist; (2) the absent-minded professor; (3) the inhuman rationalist; (4) the heroic adventurer; (5) the impotent scientist; (6) the social idealist.

Finally, it is important to note that this data collection adhered to and respected the ethical principles inherent to any research work. The viewing of the short films was conducted via the FilmFreeway platform, with authorised access granted by the festival's organising team, who were duly informed of the objective of this study.

4 · Results

This study was designed and developed to understand how science is represented in independent cinema, based on the short films submitted to the first edition of the Braga Science Film Fest, an international science film festival. A total of 170 short films were analysed, of which 99 were documentaries, 39 were animated films, and 32 were fiction films. The study identified the most depicted scientific themes and fields of research and examined whether representations of science in independent cinema reflect or perpetuate stereotypes about scientists. The results reveal that scientists are depicted, in 47 per cent of the analysed films, mainly as adult white men. However, apart from the use of glasses, they do not embody the physical attributes traditionally associated with the figure of the scientist [Chambers, 1983]. They do not wear lab coats or carry notebooks or books. Science is portrayed as an activity conducted by intelligent individuals in isolation, represented as a predominantly individual endeavour. Pérez et al. [2001] observe that this individualistic and elitist perspective of science is associated with an empirical conception of 'discovery' and promotes a decontextualised interpretation, potentially influencing the public's perception of what science is. The cinematic trend of youth culture, that Weingart et al. [2003] did not identify in their study, was also not observed here. Only 31 per cent of the fiction and animated films analysed depict young scientists, aged between 20 and 35 years. In documentaries, the proportion drops to just 13 per cent, with filmmakers opting to collaborate with older scientists, some even with greying hair (25 per cent). However, unlike previous studies that portray the scientist as a mad chemist or a dangerous figure [Weingart, 2007; Kirby & Ockert, 2021], the short films analysed here present greater diversity, both in areas of specialisation and in the behaviour demonstrated by the scientists. The study revealed that astronomers, doctors, climate researchers, and particle physicists are the most represented in independent short films about science. The Exact and Natural Sciences, or 'laboratory sciences', thus reinforce the stereotypical view that only these constitute the scientific universe, relegating areas of knowledge such as the Social and Human Sciences to a secondary role in the representation of science [Abreu & Mastella, 2014] (see Figure 1).

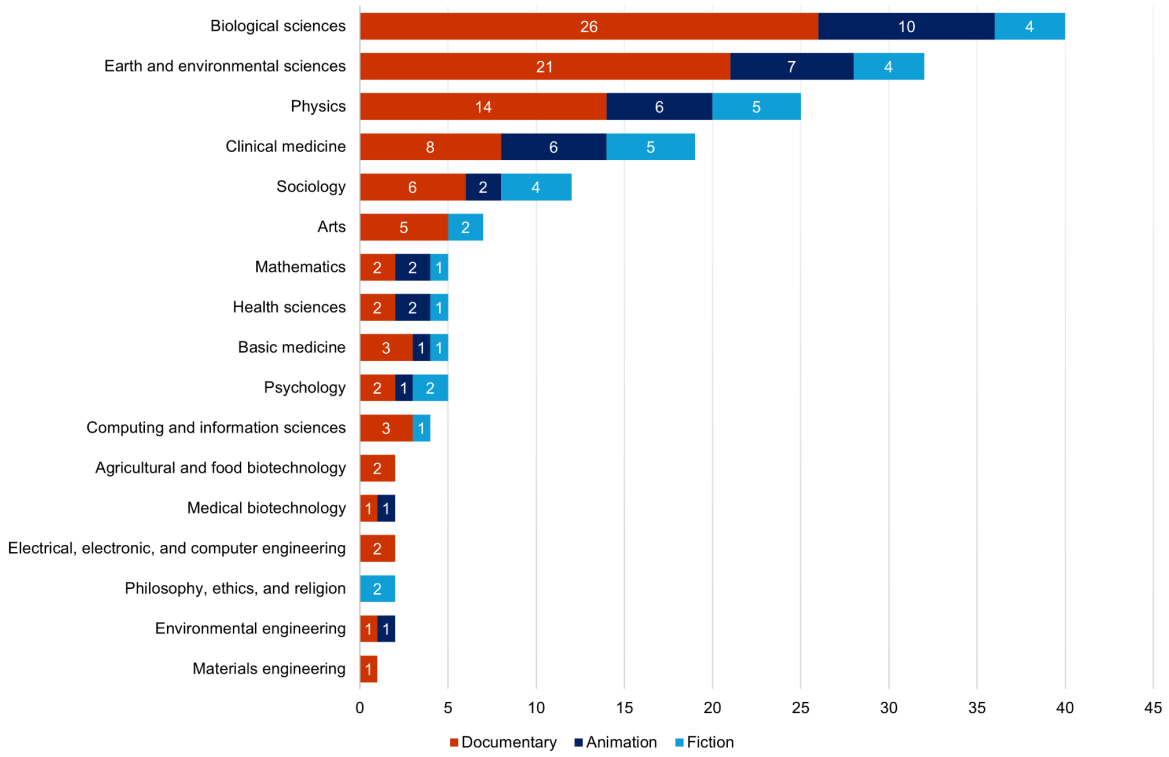

Figure 1. Domains of knowledge of the short films under analysis (n = 170).

This situation highlights a discrepancy in the valuation of different fields of knowledge, suggesting a hierarchy that does not adequately reflect the diversity and complexity of scientific activity. The figure of the mad scientist is still used in cinematic narratives, but with less prominence and far from the laboratory and Chemistry — this figure was only identified in two fiction films, associated with the disciplines of Astronomy and Physics, and whose narratives explore humour and mystery. In contrast to previous studies [Weingart et al., 2003; Flicker, 2003], this analysis observed a representation of women in science very close, in number, to their male counterparts: only 11 percentage points separate them. Although men still form the majority, the reversal is evident in animated short films, where women emerge as the predominant representation of the scientist. The laboratory is the setting most frequently used by filmmakers to place scientists (see Figure 2), reinforcing the idea of isolation and evoking the image of the alchemist [Weingart, 2007; Kirby & Ockert, 2021], although it is important to note their increasingly frequent presence in public spaces, especially in environments for collecting scientific data, universities, and museums.

This form of representation, which in the case of documentary short films, surpasses the presence in the laboratory, seems to reflect the role that scientists assume in the modus operandi of technoscience. According to Castelfranchi [2008, cited by Reznik et al., 2019], in technoscience, scientists' roles are multifaceted, allowing them to act simultaneously as teachers, researchers, consultants, among others. The emergence of the entrepreneurial scientist is seen by the author as an example of this new role, where scientists invest in themselves as entrepreneurs, and science is produced within an economic logic. Castelfranchi [2008, cited by Reznik et al., 2019] also highlights the importance of communication and a network of actors who act as communicators, including the scientists

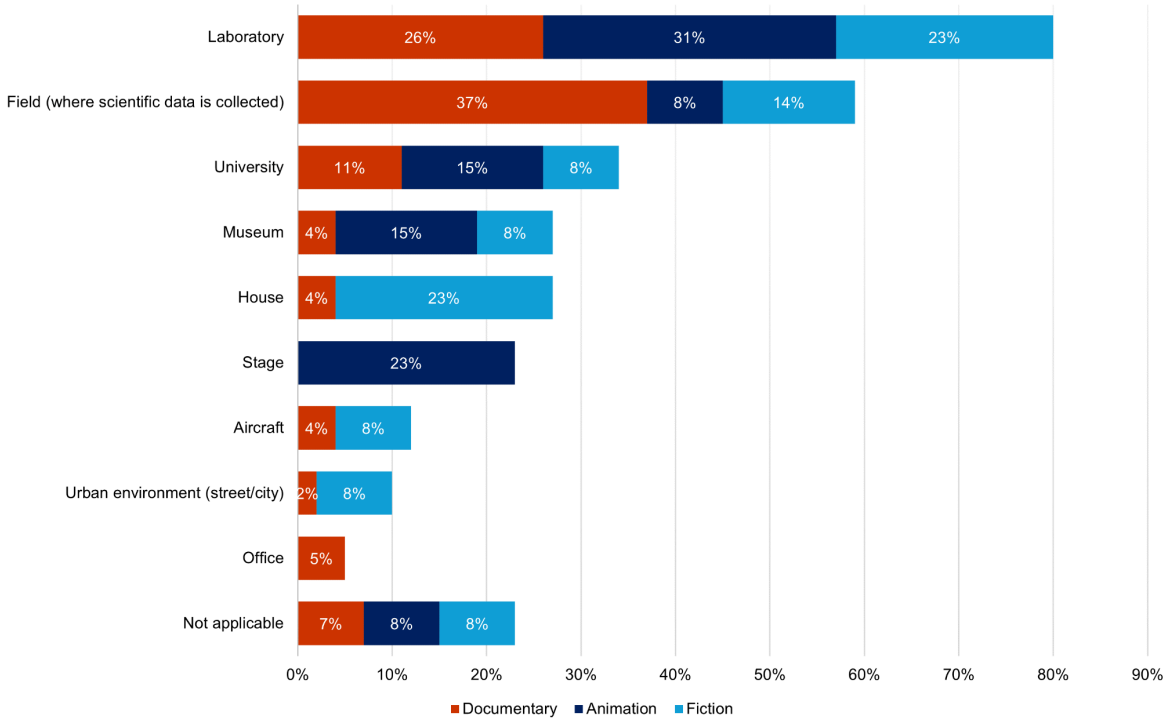

Figure 2. Location where the scientists featured in the short films (n = 80) appear on screen.

themselves, under this new technoscience paradigm. This occupation of public space is also reflected in the themes that emerge in the analysed short films, which are directly related to current debates in the public arena: the fight against climate change, space exploration, and cancer research. A central aspect of the narratives is the explanation of scientific terms or concepts, considered by León [2008] as one of the essential criteria for adequate science coverage. A contextualised understanding of science, along with the recognition and understanding of its social nature, are crucial elements for a more accurate representation of science. The absence of these elements is identified by Pérez et al. [2001] as one of the problematic and distorted perspectives of scientific work. Regardless of the cinematic genre, controversies, harm, or potential risks of science were left out of these narratives. Filmmakers chose to promote its didactic/educational dimension (see Figure 3), and few mention unintended consequences of scientific discoveries, such as the misuse of artificial intelligence or the adverse effects of technological development on the climate.

This study, therefore, reveals a complex landscape of science representation in independent cinema, highlighting both persistent patterns and significant changes in cinematic narratives. Although scientists are still predominantly portrayed as white adult men, the study identified diversification in their areas of specialisation and behaviours. The emergence of female scientists as protagonists, especially in animated short films, suggests a movement towards more equitable representation in cinema. However, challenges persist, such as the tendency to situate scientific narratives in the isolation of the laboratory and the predominance of the Exact and Natural Sciences, which may have significant implications for the public's perception of science. The results of this study point to the need for a more comprehensive approach to the ethical and social implications of science in independent cinema. While the analysed narratives emphasise the educational dimension of science, few address the

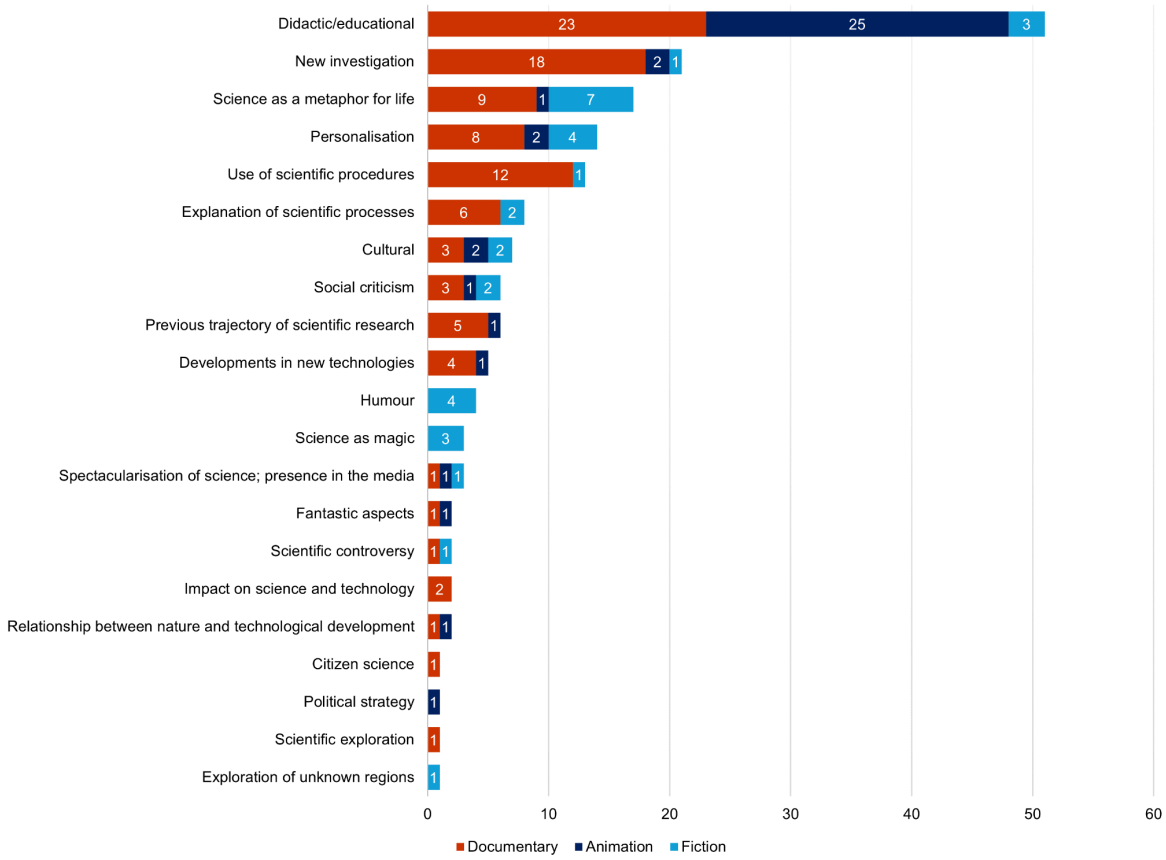

Figure 3. Scientific and social dimensions identified in the short films under analysis (n = 170).

controversies and risks associated with scientific and technological advancement. This suggests a gap in the representation of the complexities and ethical dilemmas inherent to scientific research. For a more complete and responsible understanding of science in films, it is essential that filmmakers consider not only the explanation of scientific concepts, but also the ethical, social, and environmental implications of their narratives.

5 ▪ Discussion

Cinema has the power to create, recreate, and expand universes. It is not merely confined to entertaining or embellishing reality, but also possesses the ability to disturb and provoke discomfort. The science short films analysed here are not limited to a single style; they represent narratives that reflect the ideas and thoughts of filmmakers from different parts of the world, yet share a common goal: to engage the audience visually, aurally, and emotionally. As Jürgens et al. [2024] have pointed out, cinema serves as a powerful cultural tool, with the ability to influence how the public perceives scientific concepts and technological advancements.

In its inception, cinema has had scientific purposes, yet it has faced criticism for its dual role as both a scientific tool and an object of mass entertainment. As this relationship has evolved, cinema has become an essential mediator between reality and fiction, influencing how the public perceives science. Recent studies, such as those by Brewer and Ley [2021],

highlighted the growing recognition of cinema not only as an entertainment medium but also as a legitimate tool for science communication. The growing collaboration between scientific institutions and filmmakers helped to create more informed and engaging representations of science. Understanding these representations allows science communicators to address misconceptions, challenge stereotypes, and enhance communication, promoting a more accurate, effective, and ethical understanding of science [Brewer & Ley, 2021].

However, much of the research in science communication has focused primarily on Hollywood films, often neglecting the innovative approaches seen in indie films. Independent cinema is attracting an increasingly large audience due to its ability to offer alternative narratives and more diverse representations of science. This shift, as noted by Davies et al. [2019], provides a counterpoint to mainstream cinema, offering filmmakers the freedom to explore complex or controversial themes. Independent cinema challenges conventional perceptions and fosters a broader, more informed dialogue on scientific topics. Despite facing challenges such as resource limitations and competition in the entertainment market, independent cinema can be a powerful tool for educating, inspiring, and mobilising audiences on important scientific issues.

This study offers insights into how science is portrayed in independent cinema, contributing to a broader understanding of its representation. By examining the portrayal of science and scientists through the lens of independent cinema, the study lifts the veil on ways in which these representations reflect shifts in how scientific knowledge is viewed and understood. The findings suggest that independent cinema may offer alternative perspectives on the scientific community, providing a more inclusive portrayal in some cases.

One of the contributions of this study is the observation that, while scientists are still predominantly depicted as white adult men, the representation of women scientists, particularly in animated films, is a notable shift towards more diverse and equitable portrayals. Moreover, the study observed a greater diversity in the scientific specializations depicted, such as the inclusion of astronomers or climate researchers, which presents a broader understanding of the scientific community compared to earlier trends.

Another finding of this study is the exploration of the individualistic portrayal of scientists, which persists in many films, yet differs from traditional depictions that often emphasise the solitary “mad scientist” or the “heroic genius”. Although the portrayal of scientists as isolated figures continues, the study revealed that a more collaborative and interdisciplinary representation of science is emerging. This evolution reflects changes in the scientific community, where scientists are increasingly seen as communicators or even entrepreneurs, working within networks that extend beyond the laboratory [Castelfranchi, 2008, cited by Reznik et al., 2019].

While this study fulfils its primary objective of profiling science in independent short films, it is essential to acknowledge that the sample was limited to films submitted to a specific festival, which may influence the results. To expand the scope and ensure more robust findings, future research could explore whether the same patterns emerge when including films from other festivals or with a more balanced distribution between animated, fiction, and documentary films.

Findings from studies like this one may offer useful insights for science communicators, helping them understand the image of science that is reaching the public and enabling them

to refine their strategies and communication more effectively [Jürgens et al., 2024]. This is because, although science communication was originally conceived to promote, educate, and disseminate scientific knowledge, it should also trigger a range of mental responses to the conveyed messages.

Non-mainstream films play a key role in shaping the cultural imagination of science [Davies et al., 2019]. By stimulating interest in science, cinema can inspire a new generation of scientists and citizens, ready to tackle global challenges and make informed decisions based on scientific evidence.

References

Abreu, M. A., & Mastella, V. (2014). A representação da ciência no cinema — Um olhar sobre os filmes campeões de bilheteria, na perspetiva da análise crítica do discurso. In *Anais do XIX Seminário Interinstitucional do Ensino, Pesquisa e Extensão*.

Bauer, M., Ragnarsdottir, A., Rudolfsdottir, A., & Durant, J. (1995). *Science and technology in the British press, 1946–1990: a systematic content analysis of the press*. The Science Museum. London, U.K. http://eprints.lse.ac.uk/id/eprint/68551

Braga Science Film Fest. (2023a). *International science short film festival*. https://bragasciencefilmfest.com/thefestival/

Braga Science Film Fest. (2023b). *Rules & Terms*. FilmFreeway. https://filmfreeway.com/BragaScienceFilmFest/

Brewer, P. R., & Ley, B. L. (2021). *Science in the media: popular images and public perceptions*. Routledge. https://doi.org/10.4324/9781003190721

Canales, J. (2011). Desired machines: cinema and the world in its own image. *Science in Context*, *24*(3), 329–359. https://doi.org/10.1017/s0269889711000147

Carvalho, J. (2022). Recensão crítica de Augusto, M. 2021. Como se fosse um romance: a mais curiosa história do cinema. Bertrand Editora, 343 pp. *Rotura — Revista de Comunicação, Cultura e Artes*, *2*(2), 75–78. https://doi.org/10.34623/datg-wn34

Chambers, A. C. (2022). Representing women in STEM in science-based film and television. In C. G. Jones, A. E. Martin & A. Wolf (Eds.), *The Palgrave handbook of women and science since 1660* (pp. 483–501). Springer International Publishing. https://doi.org/10.1007/978-3-030-78973-2_23

Chambers, D. W. (1983). Stereotypic images of the scientist: the draw-a-scientist test. *Science Education*, *67*(2), 255–265. https://doi.org/10.1002/sce.3730670213

Davies, S. R., Halpern, M., Horst, M., Kirby, D. A., & Lewenstein, B. (2019). Science stories as culture: experience, identity, narrative and emotion in public communication of science. *JCOM*, *18*(05), A01. https://doi.org/10.22323/2.18050201

DGEEC. (2007). *Classificação de domínios científicos e tecnológicos (FOS)*. Direção-Geral de Estatísticas da Educação e Ciência. Lisbon, Portugal. https://estatistica.dgeec.mec.pt/docs/docs_cdr/Classificacao_FOS_VersaoPortuguesa.pdf

Faria, C. A. G. (2015). *Design da animação no Brasil: um censo demográfico* [Bachelor's Thesis]. Universidade do Estado de Minas Gerais.

Flicker, E. (2003). Between brains and breasts — women scientists in fiction film: on the marginalization and sexualization of scientific competence. *Public Understanding of Science*, *12*(3), 307–318. https://doi.org/10.1177/0963662503123009

Gebacz, C. C. (2015). *Why so short?: The changing world of the short film industry and online distribution* [Bachelor's Thesis]. Ohio University. http://rave.ohiolink.edu/etdc/view?acc_num=ouhonors1429898301

Giannoni, D. S. (2008). Popularizing features in English journal editorials. *English for Specific Purposes*, *27*(2), 212–232. https://doi.org/10.1016/j.esp.2006.12.001

Goldsmith, J. (2023, December 31). Indie film's breakout year: good movies gain traction amid strikes & superhero fatigue. *Deadline*. https://deadline.com/2023/12/indie-box-office-rises-in-2023-amid-superhero-fatigue-strkes-1235683810/

Gouyon, J.-B. (2016). Science and film-making. *Public Understanding of Science*, *25*(1), 17–30. https://doi.org/10.1177/0963662515593841

Gregory, J., & Miller, S. (1998). *Science in public: communication, culture, and credibility*. Plenum Press.

Haynes, R. D. (1994). *From Faust to Strangelove: representations of the scientist in Western literature*. John Hopkins University Press.

Haynes, R. D. (2016). Whatever happened to the 'mad, bad' scientist? Overturning the stereotype. *Public Understanding of Science*, *25*(1), 31–44. https://doi.org/10.1177/0963662514535689

Hope, T. (2010, July 21). The good machine no-budget commandments. *Hope for Film*. https://hopeforfilm.com/2010/07/the-good-machine-no-budget-commandments.html

Jürgens, A.-S., Darragh, L., Peace, P., Agha, R., Viana, J. N., & Richards, I. (2024). Studying science in pop culture through textual analysis. An introduction to examining science in visual texts — street art, comics and (animated) film. *JCOM*, *23*(03), Y01. https://doi.org/10.22323/2.23030401

Kirby, D. A. (2007). The devil in our DNA: a brief history of eugenics in science fiction films. *Literature and Medicine*, *26*(1), 83–108. https://doi.org/10.1353/lm.2008.0006

Kirby, D. A. (2008). Cinematic science. In M. Bucchi & B. Trench (Eds.), *Handbook of public communication of science and technology* (pp. 41–56). Routledge. https://doi.org/10.4324/9780203928240

Kirby, D. A., & Ockert, I. (2021). Science and technology in film: themes and representations. In M. Bucchi & B. Trench (Eds.), *Routledge handbook of public communication of science and technology* (3rd ed., pp. 77–96). Routledge. https://doi.org/10.4324/9781003039242

Koehler, C. M., Bloom, M. A., & Binns, I. C. (2013). Lights, camera, action! Developing a methodology to document mainstream films' portrayal of nature of science and scientific inquiry. *The Electronic Journal for Research in Science & Mathematics Education*, *17*(2). https://ejrsme.icrsme.com/article/view/11453

Kool, D., Azevedo, N. H., & Avraamidou, L. (2022). The lonely heroine: portrayal of women scientists in films. *Educational Media International*, *59*(2), 150–171. https://doi.org/10.1080/09523987.2022.2101205

León, B. (2008). Science related information in European television: a study of prime-time news. *Public Understanding of Science*, *17*(4), 443–460. https://doi.org/10.1177/0963662506073089

Levy, E. (1999). *Cinema of outsiders: the rise of American independent film*. NYU Press.

Lewis, D. (2020, April 16). On watching 'Contagion': what do we learn? *The London School of Economics and Political Science*. https://blogs.lse.ac.uk/socialpolicy/2020/04/16/on-watching-contagion-what-do-we-learn/

Merzagora, M. (2010). Reflecting imaginaries: science and society in the movies. In A. Smelik (Ed.), *The scientific imaginary in visual culture* (pp. 39–51). V&R unipress. https://doi.org/10.14220/9783862347568.39

Oliveira, B. J. (2006). Cinema e imaginário científico. *História, Ciências, Saúde — Manguinhos*, *13*(suplemento), 133–150. https://doi.org/10.1590/s0104-59702006000500009

Ortner, S. B. (2012). Against Hollywood: American independent film as a critical cultural movement. *HAU: Journal of Ethnographic Theory*, *2*(2), 1–21. https://doi.org/10.14318/hau2.2.002

Pérez, D. G., Montoro, I. F., Alís, J. C., Cachapuz, A., & Praia, J. (2001). Para uma imagem não deformada do trabalho científico. *Ciência & Educação (Bauru)*, *7*(2), 125–153. https://doi.org/10.1590/s1516-73132001000200001

Reznik, G., Massarani, L., & Moreira, I. C. (2019). Como a imagem de cientista aparece em curtas de animação? *História, Ciências, Saúde — Manguinhos*, *26*(3), 753–777. https://doi.org/10.1590/s0104-59702019000300003

Rogers, K. (2020, April 2). 'Contagion' vs. coronavirus: the film's connections to a real life pandemic. *CNN*. https://edition.cnn.com/2020/04/02/movies/contagion-movie-versus-coronavirus-scn-wellness/index.html

Shapin, S., & Schaffer, S. (1985). *Leviathan and the air-pump: Hobbes, Boyle, and the experimental life*. Princeton University Press.

Simis, A. (2018). "Cinema independente" no Brasil. *Revista Brasileira de História da Mídia*, *7*(1), 96–110. https://doi.org/10.26664/issn.2238-5126.7120186988

Soucy-Humphreys, J., Judd, K., & Jürgens, A.-S. (2023). Challenging the stereotype through humor? Comic female scientists in animated TV series for young audiences. *Frontiers in Communication*, *7*, 1024602. https://doi.org/10.3389/fcomm.2022.1024602

Steinke, J. (2005). Cultural representations of gender and science: portrayals of female scientists and engineers in popular films. *Science Communication*, *27*(1), 27–63. https://doi.org/10.1177/1075547005278610

Steinke, J., Applegate, B., Lapinski, M., Ryan, L., & Long, M. (2012). Gender differences in adolescents' wishful identification with scientist characters on television. *Science Communication*, *34*(2), 163–199. https://doi.org/10.1177/1075547011410250

Tudor, A. (1989). Seeing the worst side of science. *Nature*, *340*(6235), 589–592. https://doi.org/10.1038/340589a0

Varghese, S. A., & Abraham, S. A. (2004). Book-length scholarly essays as a hybrid genre in science. *Written Communication*, *21*(2), 201–231. https://doi.org/10.1177/0741088303262844

Vidal, F. (2018). Introduction: from "The popularization of science through film" to "The public understanding of science". *Science in Context*, *31*(1), 1–14. https://doi.org/10.1017/s026988971800008x

Weingart, P. (2007). Chemists and their craft in fiction film. In J. Schummer, B. Bensaude-Vincent & B. Van Tiggelen (Eds.), *The public image of chemistry* (pp. 81–96). World Scientific. https://doi.org/10.1142/9789812775856_0004

Weingart, P., Muhl, C., & Pansegrau, P. (2003). Of power maniacs and unethical geniuses: science and scientists in fiction film. *Public Understanding of Science*, *12*(3), 279–287. https://doi.org/10.1177/0963662503123006

About the authors

Edite Felgueiras is a Digital Media Ph.D. student at the University of Porto, Portugal, where she investigates the impact of interactive narrative systems on science communication. Edite holds a master's degree in Science Communication and was a recipient of a Fulbright Grant at Stanford University.

edite.felgueiras@gmail.com

Teresa Ruão is an Associate Professor with Habilitation at the Department of Communication Sciences of the University of Minho. She currently serves as Pro-Rector for Institutional Communication at the same institution, a position she has held since 2021. She teaches and conducts research in the areas of Organisational and Strategic Communication, Branding, and Public Relations.
She holds a Ph.D. in Communication Sciences from the University of Minho (2008) and has been a researcher at CECS — Communication and Society Research Centre since its foundation in 2001. She served as Vice-President and President of the Pedagogical Council of the Institute of Social Sciences at the University of Minho (2009–2019) and as Deputy Director of CECS (2019–2021).
She is a founding member of SOPCOM — the Portuguese Association of Communication Sciences, served on the board of the 'Organisational Communication Working Group' from 1997 to 2015, and coordinated this group between 2016 and 2017. She is also a member of ECREA — European Communication Research and Education Association,
IAMCR — International Association for Media and Communication Research, and a regular reviewer for ICA — International Communication Association.
Since 2017, she has been an evaluator for the Portuguese Foundation for Science and Technology, and since 2019, for the National Agency for Accreditation.

truao@ics.uminho.pt

How to cite

Felgueiras, E. and Ruão, T. (2025). 'Science on screen: the representation of science in independent films'. *JCOM* 24(03), A02. https://doi.org/10.22323/2.24030202.

ISSN 1824-2049. Published by SISSA Medialab. jcom.sissa.it