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Studying science in pop culture through textual analysis. An introduction to examining science in visual texts — Street art, comics and (animated) film

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Abstract
Textual analysis is a commonly-used qualitative method for analysing and interpreting cultural texts. This approach elicits how representations occur, their underlying assumptions and how they come to have meaning. Despite the popularity and utility of textual analysis, its interpretive and theoretical strategies are not comprehensively described in science communication research. To fill this gap and clarify how textual analysis can be used to unpack the cultural meanings and representation of science in visual texts — images, comics and films — the authors analyse and discuss four environmentally-themed scholarly articles that apply textual analysis. This showcases the value of textual analysis in investigating and understanding the relationships between pop culture and science, demystifying it for science communication students and researchers.

Introduction

Picture this: You are interested in science communication and have just come out of the cinema, a comic book shop or are wandering through your favourite public space where science expressions are muralised. You are inspired and have many questions about the science and how it is communicated, the messages and meanings conveyed and the emotions evoked. You want to analyse and interpret the science portrayed in these visual media. For example, you may want to explore how street art depicting threatened species encourages pro-environmental behaviour, how animated films like *Wall-E* or *The Lorax* raise awareness of climate change or how comic book heroes like Poison Ivy precipitate concerns around mass extinction. You may be interested in how science influences the characters or the plot, and how these texts reflect cultural imaginations and interpretations of

science. However, you are not completely sure where to start, and wonder: How do you study and analyse science in pop culture?

Films, comics and street art are part of pop culture, but they are also visual *texts*. One method to study them is called textual analysis. It is a common qualitative method used in humanities research, particularly in cultural and literary studies, to explore a variety of texts — from written to verbal, fiction to nonfiction and visual to auditory. Textual analysis helps us understand and explain depictions, assumptions and meanings — particularly in relation to social, political, cultural and artistic contexts.

For years, students and researchers from the Australian National Centre for the Public Awareness of Science at The Australian National University have discussed different approaches to examining the representations, dynamics and facets of science in pop culture from a science communication perspective. While textual analysis is employed by science communication scholars, it is not always recognised and described as such [Braun & Clarke, 2006; Hawkins, 2017; Rauscher, 2014]. It can be carried out without extensive description of the process, theories, methods and/or background information that contributed to, or influenced, the analysis. Therefore, there are gaps in the type and availability of information about methodological approaches to textual analysis in the humanities and beyond.

In the following sections, we draw on academic science communication articles that employ textual analysis to explore environmental themes in street art, comics and (animated) film. By unpacking how these culturally-oriented science communication articles use textual analysis — in light of its humanities context — we hope to better orient science communication researchers interested in investigating the pop-cultural power of science. This paper can serve as a useful and accessible teaching and research tool for science communication students and researchers who are new to textual analysis.

Meanings and methods

Science in pop culture is where science communication meets the humanities. If you are interested in the meanings and dynamics of science in visual texts, your interest taps into academic disciplines that study human society and culture, e.g. history, ancient and modern languages, literature, philosophy, visual and performing arts. They explore the human experience, memory and imagination — how we shape and are shaped by our world.

Humanities scholars are interested in asking questions, rather than seeking definitive answers. Their research methods are interpretive, critical or speculative in nature, and they often include a historical/contextual element — because expressions of human and social experiences cannot be adequately captured by objective facts, figures and numbers alone. These methods are distinct from those in natural and social sciences, where data from empirical approaches are typically considered essential to understanding phenomena. In the humanities, concepts, modes of criticism and methodological perspectives are numerous and diverse.

Most methodologies (approaches) in the humanities can be categorised as extrinsic/contextualist and intrinsic/isolationist. An extrinsic and contextual approach places the research within a specific historical and cultural context. It

illuminates possible factors that influenced and shaped a specific text, idea or person during a specific point in time. Intrinsic or isolationist approaches are exclusively concerned with the 'structure' and 'materials' that make up a text (extensively described in Houston [2016]) — the various elements that make up form and content, as well as the innate and unique relationship that these various elements have.

Texts and textual analysis

In everyday use, a *text* is referred to as any spoken or written communication, and this can include fiction and non-fiction. The humanities adopt a broader definition that includes visual materials; a text is something that we make meaning from. As Alan McKee [2003] describes, whenever we produce an interpretation of something's meaning — a book, television programme, film, magazine, T-shirt or kilt, piece of furniture or ornament — we treat it as a text. Texts are valuable artefacts of popular culture. They convey meaning; connect us through new ideas, shared experiences and entertainment; and even exert influence on our daily lives — from how we understand and engage with topical scientific issues to how we navigate important political decisions. Given the power and influence of texts, textual analysis is a crucial method of data collection and interpretation; and understanding and explaining different representations, assumptions and meanings. Depending on your purpose and approach, you can extract different types of information, identify themes and their significance and apply further analytical techniques to engage their meanings.

All kinds of information can be gleaned from a text — from its literal meaning to the subtext, symbolism, assumptions and depicted values. These can help you understand and appreciate the influence texts have in society. Science-fiction texts, for example, have a long history of challenging and contributing to ideas in science, technology and culture. They can inspire technological innovations, such as the first iterations of the mobile phone (inspired by *Star Trek*) and genetic technologies that can facilitate the resurrection of extinct species (inspired by the *Jurassic Park* universe [Jones, 2019]). They can also encourage ethical reflection, by presenting contemporary society and 'possible' futures, such as those depicted in the *Jurassic Park* films [Stelmach, Nerlich & Hartley, 2022] and the *Black Panther* franchise. By analysing literary texts, you study processes of sense-making, how structures of thoughts and patterns are staged or presented and how specific characteristics create meaning. You can trace factors of influence; discover common motifs, knowledge and attitudes; explore unintended and unexpected connections; and ultimately generate, and contribute to, new perspectives. This exposes discourses about, and around, a certain topic, which illuminates its distinctiveness and impact in, or to, a particular context. Jensen [1991] describes qualitative textual analysis as an approach to study how meaning is produced contextually, inextricably linking a text to broader social contexts and cultural practices.

When studying science depictions in film, images or photographic texts, visual signs are investigated. As a detective of signs and meanings, you can explore this process yourself by examining Figure 1. With no (real) words to distract you, what does the text signify to you? It is important to remember that visual texts like Figure 1 are "stories that are organised visually" [Schirato & Webb, 2020, p. 9]. They consist of visual signs that mean '*some*thing', not '*one* thing' — signs can mean different things depending on context [Schirato & Webb, 2020, p. 7].

Figure 1. Analysing and interpreting texts by means of textual analysis turns us into *meaning detectives*. Textual analysis creates rich layers of meaning and reminds us, yet again, that texts are more than just written words. Image: "Textus 2" orchestrated in MidJourney by TA.

Using textual analysis to study science in pop culture — street art, comics and animated film

If you are new to textual analysis, you may be wondering which way to go. The following case studies will guide your journey. In this section, we show different ways to conduct textual analysis by unpacking the methods used in a selection of science/environmental communication academic articles. The following are examples of how researchers use textual analysis in the science-in-pop-culture space to discuss cultural meanings of science. We have chosen academic papers that discuss environmental issues, in the hope of illustrating different ways of exploring a particular theme. The methodologies, approaches and emphases discussed are used across a variety of media and topics. We do not provide a synthesised singular protocol; rather, in line with the humanities tradition of textual analysis, we present a myriad of possibilities for interrogating the cultural representations and repercussions of science.

Studying images: street art

The use of street art as a vehicle for science communication is receiving increasing attention and commendation. Thompson, Jürgens, Bohie and Lamberts [2023] describe street art as public art in public places that addresses a highly diverse audience. It may be a producer of, and produced by, public knowledge and perceptions of the environment, as mediated by science and popular culture.

Thompson et al. [2023] critically analysed a series of painted murals to better understand the artist's participatory, community-embracing approach in creating science-related public environmental artworks, and the mechanisms of how, and which, environmental issues are communicated. The researchers probed the communicative role of art in less-tangible science contexts, the strategies used to communicate messages and the use of street art for creative grassroots environmental communication.

For their analysis, the researchers situated the art in time (history) and place (culture). It was recent, and set in the cultural context of legal street art spaces in Canberra, Australia; an urban environment, with exposure to passers-by. Thompson et al. [2023] described their 'environmental street art' selection criteria as "1) [the artworks] were created in the past few years, 2) they are large, detailed and visually stimulating; 3) they explore different environmental themes; [and] 4) they are figurative (not based on abstract/geometrical patterns)." Data sampling for the 'corpus' of art can be carried out in different ways and will depend on the research question. It is typically informed by individual interests, funding agreements, geographical interest, theoretical gazes and critical lenses. The wider historical context of street art as a medium is also described: "Street art evolved from graffiti as a form of artistic expression, social intervention and protest" [Thompson et al., 2023, Section 3, paragraph 1]. Additionally, "it is largely ephemeral, non-commercial art that is free to experience", "owned and overseen by no one (or, rather, everyone)" and linked to a street context [Section 3, paragraph 1].

The fact that many of these murals are commissioned in partnership with local government reinforces the importance of contextual factors that influence and shape a text. This is because when art is commissioned, there are various influences on the topic, its expression or the inclusion of controversial and sensitive subject matters. By contrast, non-commissioned works provide greater freedom of expression and may draw upon other influences — such as what the artist, their community or audience might want to see. In some contexts, works may also be considered illegal. This can create practical and ethical issues for researchers, such as locating and engaging with the artist. The authors also describe the audience for the artworks: a wide variety of passers-by who would vary by ethnicity, sex, gender, values, political persuasions and more.

Thompson et al. [2023] examined the individual components of the murals and how these relate to each other to understand the meanings they create, and the context they use to convey an environmental message. This is an example of an approach to textual analysis called 'close reading'. Close reading involves paying "close attention to textual details with respect to elements such as setting, characterisation, point of view [. . .]. Often, close reading concerns the dichotomy between what the text literally says and what can be inferred" [Rapaport, 2011,

p. 4]. This approach allows for the discovery of "deeper themes" in the core material and thus turns authors into "message investigator[s]" [De Castilla, 2017, p. 137] (see 'meaning detective' in Figure 1).

To further inform their methodological and interpretive frameworks, Thompson et al. [2023] built on the artist's description of the murals via informal conversations with her. The artist provided insight into the context, motives, influences, inspirations and meanings associated with her murals. In doing so, she also shared aspects of the creative process — from the emergence of the idea, to community participation and influence. For example, the artist included a reusable cup in a piece after learning that Australians throw out 1 billion (now 1.8 billion) single-use hot beverage cups every year [O'Farrell, Harney & Chakma, 2021, see table 46]. Following a conversation with a coffee shop owner on the use of coffee ground waste for commercial mushroom production, the artist consulted scientific research on uses for fungi and from there, she took an interest in the role of fungi in ecosystems and their necessity in the food system.

The researchers in this article did not seek a singular, true, accurate, final or generalisable reading. That is, different researchers will most likely form different analyses and conclusions, and one interpretation is not (more) correct. For example, Thompson et al. [2023] read the particular artwork as inspiring change through humour, hope and empowerment. Different researchers, or indeed passers-by, might develop alternative interpretation(s) depending on a range of factors. For example, one of the artworks contained the words "INSPIRE GROWTH". This might be read as relating to personal growth, or perhaps greater maturity in governance. A critical environmentalist might interpret this as encouraging economic growth — something that is damaging the environment [Cosme, Santos & O'Neill, 2017; Kallis et al., 2018] — perhaps linking it to the perennial pursuit of the artist's government sponsor. Despite there being no attempt at a 'true' reading, Thompson et al. [2023] point out that there are limits to what interpretations and claims would be classed as reasonable at a given historical and cultural juncture.

Studying comics: visual fiction

Comics have been examined as tools for teaching and improving student engagement and motivation [Farinella, 2018; Jee & Anggoro, 2012], as well as cultural platforms for reflecting polarising images of science [Jürgens, Tscharke & Brocks, 2021]. Comics exploring fictional worlds (such as DC or Marvel comics; for other forms of comics see Jonsson, Brechensbauer and Grafström [2022]) can feature metaphorical representations that "can be mapped" onto our [world] — and thus be more "meaningful in some ways than an accurate depiction of our image world" [Wolk, 2007, p. 134]. You can find studies of science in comics and graphic novels in humanities journals such as the *Journal of Graphic Novels and Comics* (see e.g. or Santos and Jürgens [2023]).

The *Journal of Science Communication* discusses the use of comics for science communication. One recent example — "Wildlife comics, or the making of young naturalists in late Franco's Spain (1969–1970)" [Tabernero, 2022] — taps into textual analysis, without explicitly saying it. This is a common phenomenon in cultural studies. Tabernero [2022] is interested in processes of construction of natural

history knowledge and analyses "two kinds" of comic series about nature and drawn narratives: fiction stories with naturalist Félix Rodríguez de la Fuente (FRF) in a central role, and educational pieces. Highlighting that comics have been largely overlooked as sources of information for historical and socio-cultural enquiry, Tabernero argues that the comics at stake "allow us to probe the combined role of science, media, and celebrity in the construction of a visual environmental culture" through narrative strategies aimed at engaging young audiences in "naturalist-like" practices.

Tabernero's article illuminates the 'real life' context of 1960s Spain; FRF positioned himself as a celebrity natural history populariser via "the skilful navigation of the Spanish government's administrative, academic and media procedures [by] establishing and calling on political and academic connections". Tabernero [2022]'s aim is to broaden the *historical* understanding of a complex interface: "the intricate relationship between communication practices, popular media, and the processes of production, circulation, and management of scientific knowledge" in comics and beyond. The article is thus an example of an *historical reading* in relation to the use of comics for science communication and public understanding/perception of science.

Given the complex focus and aim of the article, it is not surprising that the analytical steps are equally complex and multifaceted. Tabernero says that they "analyse" the comics, but they do not specify their theoretical or interpretative basis; contextual and detailed analysis are interwoven. In other words, they do not analyse the visual material per se but discuss main narrative tropes and the "naturalistic style". Here is an example of how the aesthetic/intrinsic and contextual level crossover in Tabernero's analysis of the "naturalistic style" of comics featuring FRF:

> This naturalistic take operated at two levels, at least: to start with, it imbued the narratives with a deliberate touch of authenticity, thus directly appealing to the readers' belief in the credibility of the stories [...]. Such approach aimed at bringing plots and their socio-cultural implications closer to the everyday lives of readers, and consequently became a major issue in the long and dramatic socio-political contention about the alleged pernicious effects of comics on children and young people [...].

Besides the conscious distancing from potentially harmful caricature-like styles that were commonly used in newspaper comic strips and satirical or teenager publications, the naturalistic approach also incorporated a sense of seriousness and rigour in contrast to the theoretically more ingenuous and puerile approaches designed 'just' for fun.

This study is a striking example of how context creates specific meanings and contributes to the understanding of the medium and content of comics as a pop cultural product. The examples analysed in terms of the development of aesthetics, plot and context are fascinating in the way they cross media — fictional and non-fictional.

Environmental-themed animated films have been examined through textual analysis in science and environmental communication journals. Two publications in *Environmental Communication* examine the 3D-animated films, *The Lorax* [Renaud, C. (Director), 2012] and *Wall-E* [Stanton, A. (Director), 2008]. In their recent article, Caraway and Caraway [2020] employ a deductive approach, progressing from general ideas to specific conclusions, to determine the films' portrayals of ecological crises. By contrast, Moore [2015] investigates what is *not* presented in these films to elucidate key omissions in their portrayal of environmental destruction.

What you are looking for in the textual analysis depends on what your question is. So Caraway and Caraway [2020] first specify their research question: "How are ecological conditions, processes, and crises discursively constituted in children's media as objects of human understanding?" [p. 686] They then pre-specify four themes based on a review of ecocinema studies literature — anthropocentrism and anthropomorphism, displacement, greenwashing and pastoral replenishment. The 'Method' section first mentions that they "undertake a symbolic, thematic, and ideological exploration" [p. 690]. Caraway and Caraway [2020] then rationalise their selection of the two films by highlighting commonalities in the films' target audience (children), box office success, theme (ecological crisis), accounts on the impacts of economic and technological development and narratives on the replenishment of nature. They then provide a brief synopsis for each film before describing how they conducted their textual analysis: "We looked for moments when the cinematography, editing, mise-en-scène, use of color and sound, narrative and storytelling techniques, and character development intersected with any of the major themes and concepts found in ecocinema studies." [p. 691]

Caraway and Caraway [2020] present their results in an 'Analysis' section, with several paragraphs for each theme. For their anthropomorphism theme, they describe features of characters in the film and compare them with defining characteristics of particular commercial products. For instance, Eve, one character in *Wall-E*, "is depicted as a white, sleek robot, reminiscent of something from Apple's product line." [p. 691] For their displacement theme, or the individualisation of climate change and the obscuration of systemic causes and collective solutions, they contrast *The Lorax* film's framing with that of the original book [Seuss, Dr., 1972] — the latter of which is a "devastating critique against entrepreneurialism, unrestrained economic growth, and technological development." [p. 692] On the other hand, the film's "narrative develops as a conflict between the Once-ler and the Lorax, and between the capitalist bully O'Hare and the film's protagonist Ted" which is quite different than the book's focus on "a conflict between capitalism and the natural world." [p. 692] Caraway and Caraway's [2020] article also examines *The Lorax* film's corporate partners to illustrate their theme of greenwashing. They highlight how there are, "'Lorax approved' disposable diapers, 'Truffula Chip Pancakes' at IHOP, the 'certified Truffula tree friendly' Mazda CX-5, and a partnership with Hewlett Packard" [p. 693]. Their 'Conclusion' underscores how "it is damaging to teach children that ecological destabilization can be reversed in such a way" (just by planting a seed) [p. 695]. They also suggest other films/resources — such as *FernGully* [Kroyer, B. (Director), 1992] and the original Dr. Seuss's *The Lorax* — that can be used to teach children an eco-centric and non-instrumental valuation of nature.

In the introductory paragraph, Moore [2015] "seeks to identify messages" about environmental problems and their solutions in movies for children "through the symptomatic reading defined by Althusser and Balibar" [p. 540]. The author then offers a literature review detailing how Hollywood films — such as *The Happening* [Shyamalan, M. N. (Director), 2008] and the *Fast and Furious* franchise — still promote technological products and have a central theme of consumption. In the 'Theoretical and Interpretive Frameworks' section, Moore [2015] first rationalises their film choice; they all have the environment as a central narrative and have been produced by a major Hollywood company. Moore [2015] then presents their use of Althusser and Balibar's [2009] "dual reading" approach, which "consists of an initial interpretation of a text focusing on manifest details (in this case, the narrative and characters), followed by a 'second,' deeper reading designed to reveal ideological messages through identification of key 'lacunae,' or silences in the text [...]. The central purpose of a symptomatic reading is to elucidate the problematic, which Althusser and Balibar describe as an answer given to its absent question" [p. 543].

The analysis section of Moore [2015] is divided into 'Manifest Reading' and 'Symptomatic Reading' sub-sections. For each film in the 'Manifest Reading' subsection, a brief synopsis is provided, along with information on the film's producer and accolades. For the 'Symptomatic Reading' subsection, Moore [2015] focuses on how the films portray various environmental problems and their sources. Moore [2015] criticises silences in *Wall-E*'s second half, particularly how the design of Eve signifies that cleaner technology will help protect the environment. The film invites children to "see Eve — and associated Apple products — as part of the solution to environmental problems rather than an integral part of the old, destructive consumption pattern" [p. 549]. Moore [2015] also presents background information regarding Disney's acquisition of Pixar, which enabled Steve Jobs, founder of Pixar and Apple, to become Disney's largest shareholder. In a similar vein, *The Lorax* is criticised for its "silence regarding real solutions to environmental problems, paired with the mass marketing that accompanied the film" [p. 550], especially with over seventy associated product tie-ins. The 'Conclusion' reiterates how the films "studiously avoid identifying individual sacrifice and change as the answer" [p. 551].

Moore's [2015] and Caraway and Caraway's [2020] examinations of *The Lorax* and *Wall-E* demonstrate different approaches for conducting textual analysis of animated films. While Caraway and Caraway [2020] structure their analysis based on four themes they have identified from ecocinema studies, Moore's [2015] paper is structured upon outcomes of their manifest and symptomatic readings. Looking at their analysis, both papers conduct both intrinsic and extrinsic approaches. They analyse not only how various characters are portrayed in the films, akin to intrinsic approaches; they also analyse the broader social and commercial contexts surrounding the films.

Science communication in visual fiction — conclusion

Through our analysis of select science communication publications that examine environmental themes in visual texts (street art, comics and animated film), we present several tips for conducting textual analysis (Table 1). We do not aim to provide an exhaustive list of humanities-based approaches for textual analysis; rather, we aim to introduce several elements, concepts and methods that science

communication researchers, including students, can adopt when selecting, situating and reading texts.

Table 1. Tips for conducting a humanities-based approach to textual analysis of science in popular culture, extracted from the research investigated above.

Selecting a text

– Select texts based on interests, theories, lenses, etc. These influences can be made explicit.

– When multiple texts are analysed, describe similarities (and, if possible, differences) among the selected texts.

Situating the text

– Contextualise the text in time (history) and place (culture).

– Analyse the text in relation to its authors and producers (and even interview them). Describe potential commercial/political interests in its production.

– Compare and contrast the text with other versions and adaptations (earlier/later editions, translations and representations in other media, such as books, cartoons, comics and films).

– Analyse the text in relation to communication practices, other popular media, and the processes of production, circulation and management of scientific knowledge.

– Narrative tropes can be related to more abstract philosophical or ideological questions about our relationships with the world.

– A literature review can guide and contextualise the text and research questions, in light of related publications (both on the text and on similarly-themed texts).

Reading the text

– While the theoretical or interpretive basis is not always presented, it is a good idea to provide readers with information on the lens/framework you are using to read the text.

– Describe the type of reading conducted (manifest and/or close reading). Brief descriptions and/or references to previous work employing these reading methods also need to be provided.

– Multiple symptomatic readings/viewings may be conducted. While the analysis can look only at information presented in the text, it can also explore absences (aspects that are not explicitly mentioned or portrayed).

– Contextual/extrinsic information may be woven with interpretive/intrinsic reading of the text. Both can be done.

– The humanities do not aim to provide a singular, 'true', final and generalisable reading, so do not worry if the reading deviates from other interpretations of the text. However, enrich the analysis by mentioning other interpretations and reflecting on why your reading differs from them.

As we have seen, textual analysis (in the humanities) is not about seeing how 'accurately' texts represent reality and truth. There is usually more than one approach to the topic as people make sense of reality in different ways — as visualised in Figure 2. Analysing texts from a humanities perspective does not

make claims about whether texts are "accurate", "truthful", or depict "reality".

> We do not simply dismiss them as "inaccurate" or "biased". These claims are moral ones more than anything, attempting to close down other forms of representation without engaging with them. [. . .] There is not a single, "true" account of any event, but there are limits on what seems reasonable in a given culture at a given time. [McKee, 2003]

Rather, textual analysis aims to understand and explain the ways in which these forms of representation take place, as well as the meanings and assumptions that underlie them. If you are wondering if the form of textual analysis we discuss is the only way to study pop cultural texts, then the answer is: not at all! The best method to use *depends on your research question* and the material you want to investigate. Analysing science-related images as texts — be it graffiti, comics or films — is just one way to explore how popular culture influences and is influenced by science. Other popular culture artefacts, such as popular science books [Smith, 2013] and songs [Huang & Allgaier, 2014], have also been analysed in the science communication literature. While textual analysis approaches that draw from humanistic traditions have been used in some studies [Smith, 2013], others have employed more quantitative approaches, wherein themes are analysed and reported in percentages [Huang & Allgaier, 2014]. Overall, studying science in culture — via textual analysis — matters because it can advance society's knowledge about the cultural power and human experience of science. Explorations of science in popular media can discover and exploit major overlooked cultural themes, shape new intellectual agendas, identify various visions of our humanity, create new knowledge about our science-society relationships and elucidate the contribution of science communication to cultural history. Science in pop culture can help us better adapt to and address global challenges by facilitating an engaging and impactful public understanding of scientific realities and possibilities.

Depictions of science in pop culture can significantly influence public attitudes towards science by forming, cultivating or reinforcing the cultural meanings of science. Therefore, popular culture is a versatile frame for interpreting our relationship with science. As vehicles of science communication, pop-cultural products such as (animated) films, comics and street art are invaluable resources. They reflect ideas about science and "construct perceptions for both the public and scientists in a mutual shaping of science and culture" [Kirby, 2008, p. 44]. In this context, the popularity of the television series *The Big Bang Theory* [Cendrowski, M. (Director), 2007] and the *Jurassic Park* franchise [Spielberg, S. (Director), 1993], for example, demonstrate the widespread acceptance and resonance of science-related narratives among diverse audiences. Their popularity has prompted the emergence of vibrant enthusiast subcultures within their fandoms, as well as collaborations between the scientific community and the film industry. This is exemplified by the US National Academy of Sciences' science and entertainment exchange [Zehr, 2014]. Studies of science popularisation show "that its cultural meanings, and not its knowledge, may be the most significant element contributing to public attitudes toward science", and popular images of science can "significantly influence public attitudes toward it by shaping, cultivating, or reinforcing these 'cultural meanings' of science" [Kirby, 2017, p. 11].

Unsurprisingly, textual analysis has a long history as an approach to studying science in pop culture and is increasingly contributing to understanding, education, communication and discussion of science in multiple contexts — including science communication. Among humanities approaches to textual analysis, there is strong acknowledgement of the explorative capability and interpretive power of texts, with broad consensus that texts are not merely reflections of reality. Alternatively, science, pop culture and society are regarded as mutually constituted, and thus simultaneously shape individual experiences, as well as the production, maintenance and challenging of ideas and representations of reality. Therefore, the overarching goal of textual analysis is to explain the variety of possible meanings a text may convey. Sensemaking of these complexities and realities, and the ways in which one attempts to communicate them, happens in many ways. While we discussed a few strategies of textual analysis in this paper, such as close reading and symptomatic reading, there are other approaches worth exploring. Specific theories, for example, can guide the analysis of the visual material (see Hee et al., 2022).

Figure 2. *We* give texts meaning. Textual analysis is about *our* interpretation of them. Image: "Textus 1" orchestrated in MidJourney by TA. Here, artificial intelligence added another layer to the theme of this paper: it interpreted our keywords and gave them new meanings through the visual text it created. Textual analysis 2.0.

Humanities approaches to textual analysis, and their subsequent use to study science in pop culture, confer much explorative and interpretive power. This stems from the diversity of readings and meanings that can be considered in various aspects of a text and its social milieu. In spite of its utility, textual analysis is marginally described in science communication scholarship, making it challenging for those interested in it. Recognising this challenge, this resource serves as a general guide for those who want to start studying science in pop culture, as represented in visual texts.

We leave you with a thought-provoking task that will put some of what we have covered into practice. We encourage you to look back at Figures 1 and 2 and perform a brief, informal textual analysis. You can employ some of the strategies we have covered here, referring back to Table 1 for inspiration. Some facets of textual analysis will not apply to all texts, so leave out anything that seems irrelevant. Attempt an intrinsic reading of the text's style, features and content. What do you see? Also consider performing an extrinsic reading. What meanings are conveyed? Note the context in which the texts emerge. For example, noting that the images were generated by AI, what does this say about the text's place in history? Perhaps you can combine intrinsic and extrinsic approaches? We can offer a generous hint in this regard: our theme of environmental issues featured in the artist's AI keyword prompts. What content do you see that reflects this, and why is our human relationship with the environment of such contemporary importance? You are now on your journey into the wonders of textual analysis.

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