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Audiovisual Narratives on Tik Tok: New Challenges for Public Communication of Science and Technology

Narrativas audiovisuales en Tik Tok: nuevos desafíos para la comunicación pública de la ciencia y la tecnología

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Abstract

This work analyses the presence and management New modalities of mass communication through social networks represent a major challenge for the public communication of science and technology. Science dissemination developed through media such as TV, cinema, print media and books, platforms with substantially different characteristics to those of today's digital media. The need to reach different target audiences, especially younger ones, raises different questions about the potential of the different social networks in relation to the objectives of disseminating knowledge, arousing interest and involving the public in the most relevant science and technology issues. The case of the social network Tik Tok is of particular interest, due to its clear audiovisual character, its accelerated pace and its extensive penetration within the youngest age group. For this research, we analysed the narratological resources of 200 audiovisual pieces belonging to 10 of the most globally popular scientific dissemination accounts on Tik Tok. Our analysis seeks to describe the profiles and narrative resources that characterise science dissemination on this social network. Furthermore, this description reveals that, although Tik Tok is not presented as the ideal medium for the development of complex content, its potential as an effective tool for public dissemination and engagement cannot be overlooked.

Keywords

audiovisual; science; communication; dissemination; social media; Tik Tok

Resumen

Las nuevas modalidades de comunicación masiva por redes sociales suponen un desafío mayúsculo para la comunicación pública de la ciencia y la tecnología. La divulgación científica se desarrolló y cobró forma a través de soportes como la TV, el cine, la prensa gráfica y el libro, plataformas de características muy diferentes a las de los actuales medios digitales. La necesidad de llegar a diferentes públicos, en especial a los segmentos más jóvenes, plantea diferentes interrogantes sobre las potencialidades de las distintas redes sociales en relación con los objetivos de divulgar conocimiento, concitar el interés e implicar al público en los temas más relevantes de la ciencia y la tecnología. El caso de la red social Tik Tok es de particular interés por su neto carácter audiovisual, su ritmo acelerado y su gran penetración en la franja etaria más joven. Para este trabajo se analizaron los recursos narratológicos de 200 piezas audiovisuales pertenecientes a 10 de las cuentas de divulgación científica de mayor audiencia global en Tik Tok. Nuestro análisis busca describir los perfiles y recursos narrativos que caracterizan a la divulgación científica en esta red social. Además, dicha descripción revela que, aunque Tik Tok no se presente como el medio ideal para el desarrollo de contenidos complejos, no se puede dejar de considerar su potencial como herramienta efectiva para la divulgación y la implicación pública.

Palabras clave

audiovisual; ciencia; comunicación; divulgación; redes sociales; Tik Tok

1. Introduction

The main objective of this work is to analyse the way in which public communication of science and technology (PCST) is installed in the social network Tik Tok. The importance of the proposed objective is based on two premises. The first is the social relevance of PCST, understanding it not only as an interesting academic discipline per se, but also as a system of practices aimed at informing citizens about the state of the art of scientific-technological issues for decision-making (Rodríguez, 2019; Rodríguez & Giri, 2021). This makes PCST a topic of interest for the design of public policies in general (Cortassa & Rosen, 2019; Céspedes & Chiavassa Ferreyra, 2020).

The second premise is related to the importance of social networks for the mass dissemination of not always reliable information (Zeng, Schäfer & Allgaier, 2020). This issue has led institutions of information and knowledge communication, such as the traditional media system (Martin Neira, Trillo-Domínguez & Olivera-Lobo, 2023) or formal higher education (Hayes *et al*, 2020; Radin & Light, 2023), to work in tandem with these new forms of decentred discursive production. In particular, the social network Tik Tok is shown to be a crucial one to analyse, as its content presentation format consists of very short videos and its average users are in the 16-24 age range (Torres-Toukoumidis, De-Santis & Vintimilla-León, 2021), a range especially eager to consume scientific-technological content in audiovisual formats (FECyT, 2022).

In order to achieve the general objective, we propose the following secondary objectives:

O1: To explore the specific communicational characteristics of Tik Tok as a social network.

O2: To analyse a corpus of scientific-technological popularisation videos on Tik Tok in search of their narratological characteristics and resources, their mediation processes and their rhetorical aspects.

O3: To describe the specificities of the Tik Tok network for the public communication of science and technology, in relation to its didactic, binding and representational possibilities.

The enquiry we propose is structured on the basis of the following research questions:

Q1: What communicational structures do science and technology popularisation products present in Tik Tok?

Q2: What characteristics of science and technology can be transmitted effectively with the typical contents of Tik Tok? What are the limits of this format?

Q3: What types of enunciative links are established with the Tik Tok consumer audience?

The research presented here proposes a theoretical and empirical advance on the communicational characteristics of one of the most relevant social networks in terms of its current level of impact, but also seeks to shed light on the general issue of Public Communication of Science and Technology. The post-covid era proposes the challenge of facing phenomena that, although they have existed for a long time -such as fake news, disinformation and anti-science currents (Wardle & Derakhshan, 2017; Calvo & Aruguete, 2020; Scheufele & Krause, 2019; Salgado, 2021; Iyengar & Massey, 2019; Castelfranchi & Fazio, 2021), they become critically relevant as they are enhanced by the technological features of social networks themselves (Arceneaux & Dinu, 2018; Habibi & Salim, 2021). This obliges science communicators and public policy makers to exploit the potential of social networks in depth, in order to take advantage of their benefits and to understand how these forms of communication can negatively affect the dissemination of truthful information. We hope that this research represents a novel and relevant contribution to the development of effective PCST strategies.

1.1. Scientific dissemination and social networks

Towards the last turn of the century, a mainstream trend in scientific culture studies and policies was established, the so-called "Public Engagement with Science" (PES) -or "Science in Society"-, which advocates communication with instances of dialogue between the institutions driving scientific and technological development and the general public. This dialogue is promoted as a response to a "crisis of trust" perceived from such institutions by the general public (Bauer, 2009; López Cerezo, 2017).

This movement, adopted as public policy first in Great Britain and then supra-state in the European Union (Lock, 2011), has at least two key consequences. One is that it displaces as the dominant trend the paradigms of Scientific Literacy and Public Understanding of Science (PUS), which until then had guided the popularisation of science through its traditional media: books, print media, film and television. Science popularisation flourished as a genre in these media since the second post-war period, it strengthened in the 1980s with the appearance of emblematic products such as the television

series *Cosmos* by the North American Carl Sagan or the documentary productions for film and TV by the Frenchman Jacques Cousteau. This "miracle" of science being installed with competitive products *qua* shows in the most coveted schedules of the television grid (and also generating true editorial successes) came hand in hand not only with public promotion policies, but also with a strong shift in academic studies on communication. The need to adapt content to different media audiences led to the opening of new ways of conceiving the relationship between science and citizens, where the priority was to adapt the message to arouse the interest of audiences as a vehicle for the transmission of knowledge (Bauer, 2009; Bodmer & Wilkins, 1992).

However, with the arrival of the PES paradigm, the unidirectionality of the traditional mass media came to be negatively weighted in favour of instances and devices capable of facilitating dialogue and interactivity in more direct ways between science and citizens. In the new paradigm, the primary function of transmitting knowledge becomes secondary. Television documentaries, as well as popular science books, being considered "low-involvement" media (see e.g. Bell et al., 2018), although of course surviving, remain related to the "old" way of communicating science.

This determines the other key consequence of the shift towards PES, which is the search for channels that enable a more direct and horizontal participation and exchange. Thus, when the horizon of communication ceases to be to raise the scientific culture of the public and becomes the engagement that each institution is able to achieve with the public, the traditional figure of the scientist ceases to be the axis (and even becomes stereotyped and loses value). This gives way to the figure of the charismatic "mediating angels" and, behind the scenes, to the know-how of event organisers and public relations managers (Bauer, 2009).

Once this trend was consolidated globally in the second decade of the new century, social network platforms emerged and took hold: Facebook, Twitter and Instagram, among others, and later Tik Tok. Their technical characteristics seem to be ideal for the purposes of engagement with the public, including the instantaneousness of the exchange, the apparent horizontality, an extremely precise targeting and an immediate feedback on communication actions, through "likes" and the possibility of sharing and viralising content. The figure of the "influencer" (the opinion leader in the network era) seems to correspond point by point with Bauer's description of the "mediating angel" in 2009.

Without losing sight of the risk that social networks may accentuate negative aspects that have already been criticised in the PES paradigm (e.g. the intensity of contact as an end in itself, with the risk that such contact self-evidences the "success" of the communicative action), science institutions were not unaware of the imperative of adopting this new media as part of their communication devices. And the truth is that science popularisation is also seeking its place in the new scenario. In principle, the brief and ephemeral nature of the messages - in some cases established by the technical possibilities of the channel, but in others probably assumed on the basis of a restrictive but not always inevitable social code, as it happens with all technology according to Feenberg (2012) - seems to represent a complex challenge for the genre to overcome.

Thus, science dissemination on social media faces a double challenge: on the one hand, the format restrictions imposed by the technical medium and, on the other, the tendency to prioritise engagement over the educational, informative or "cultural" purposes of communication, understood in the more traditional sense. This analysis is part of this exploration of the potential of social networks for scientific dissemination.

1.2. Consumption spaces in Tik Tok

At present, the social network Tik Tok is distinctive for its audiovisual character and has turned out to be the platform with the highest growth in users with 1,051 million active accounts since its creation in 2016 (Silverio, 2023). The exponential growth of this social network does not make it the most popular -as is the case with Facebook, YouTube, WhatsApp, Instagram or WeChat-, but it does make it the favourite of the youngest audience -between 15 and 29 years of age- who have found in this platform a space for creation and communicative development through rapid editing tools, a multiplicity of effects and sounds (Torres-Toukoumidis, De-Santis & Vintimilla-León, 2021).

In relation to the creators of contents on Tik Tok, the data indicate that 52.83% are between 18 and 24 years old and almost 9% are under 13 years old (DataReportal, 2023). This information shows that the platform satisfies a very young audience and that it responds to the communicative demands of users seeking ephemeral, fresh and fun content (Martínez-Sanz & Arribas-Urrutia, 2023). The brevity of its content is one of the main incentives for the network to survive in a saturated communication landscape and a society that accepts - but does not attend to - an increasing number of stimuli (Muñoz Gallego, De Sousa & Costa, 2023).

Initially, Tik Tok users could only record and upload 15-second videos. This limit was progressively increased to 30 seconds, one minute and even, at present, 10 minutes, due to the demand of its users to have more space for their discursive practices. Therefore, the platform's audiovisual narratives progressively lose their brevity, which allows for the strengthening and deepening of certain topics and contents.

In the case of PCST, Tik Tok's productions come into tension with the generic category of "science documentary". Certainly, since Bajtin (1982), the dialectic between permanence and change, between regularity and novelty, which is characteristic of discursive genres, has been highlighted. Nichols (1997), for his part, recognises that changes are not alien to the modalities of documentary representation, even though they give themselves to the recognition of regularities and, therefore, to their typification. The forms of documentary representation are traversed by a dialectic that tensions conventions, regulations, technical possibilities, artistic concerns, semiotic needs and socio-historical dimensions (Nichols, 1997). Tik Tok is inscribed in a knot of interest between these variables, particularly when it functions as a means of transmitting scientific content.

In general terms, science is a difficult subject to access. Young audiences, although they are usually going through formal education (secondary or higher), are coveted as a target for communication: it is here where the emergence of new followers of scientific-technological vocations is sought. In fact, the latest data on the social perception of science in Spain (FECyT, 2022) state that age is a fundamental element of the interest in science, as the willingness to consume scientific content decreases as age increases (17% of young people between 15 and 24 years old are interested in science, as opposed to 7.4% of those over 64 years old). The report indicates that social networks and videos are used more as age decreases, being the main channels of information about science on the Internet for a 15-34-year old audience. At this context, the social network Tik Tok has become a tool with great potential for the dissemination and popularisation of science, as it takes on the brevity, the audiovisual format and the novelty required by young audiences interested in science.

In addition, it is relevant to mention how lack of time, lack of supply, lack of knowledge and lack of interest have become the main reasons when people are asked about the existing barriers to participate in science-related activities (FECyT, 2022). In this sense, Tik Tok offers the possibility of providing short and attractive doses that manage to generate a first contact with science through short contents that can evolve and consolidate into longer audiovisual creations.

Finally, it is worth mentioning how the consumption model in Tik Tok has been built around the figure of the influencer as an individual character who creates and shares content with the aim of generating a community around a specific topic (Torres-Toukoumidis, De-Santis & Vintimilla-León, 2021). In this sense, the data indicate that science communicators on social networks are in third place in terms of which institutions and individuals are the most appropriate for explaining the impact of scientific advances, behind universities and public and private research centres (FECyT, 2022).

1.3. Contradictory audiences? Science in Tik Tok

The dissemination of scientific content through social networks encounters a set of obstacles that would seem to bring it close to unfeasibility. When evaluating the communicational possibilities of this discursive practice, we must consider its conditions of production, circulation and consumption (Verón, 1998). Among these conditions, we note absent features in other popular genres, such as its brief composition and fragmentary consumption. Furthermore, there is a predominance of communicational scenes tending towards enunciative symmetry, the dissimulation or non-recognition of unequal positions of intellectual authority in favour of a democratisation of opinions.

PCST textual products in networks are subject to the brevity of their generic extension and the fleeting nature of their permanence due to the demand for constant generation of content. In this way, the time to understand abstractive processes is not typical of the logics of consumption in social networks, which are governed by the economy of attention (Zulli, 2017). This double condition of brevity and non-fixity is even more accentuated in Tik Tok, perhaps the most dynamic network at present, and whose weak attentional demand can only be assimilated to the ancient practice of zapping.

Another element that contributes to generating an unfavourable scenario for PCST is the non-veridictive status of statements in the networks or, at the very least, the relaxation of the demand for veridiction. This current phenomenon is given by, among other things, the widespread use of photographic filters, deep fakes, the aestheticisation of life for its display and the authorial conflicts resulting from the use of new artificial intelligences. The photomontage is no longer exceptional and is imposing itself as a reading presupposition of online visual products. We can see reading dispositions tending towards the suspension of the critical evaluation of the conditions of truth of the statements, in favour of generating emotional responses. The referentiality to real facts as a generic reading assumption that operated in the consumption of documentaries and the press is suspended in the reading of certain texts on the networks.

The democratising pretence of the opinion liberated in the networks also leads to a communication ecosystem that is unfriendly to scientific discourse. The reticularity of online communication tends towards the non-recognition of instituted authorities, which results in science and pseudoscience competing for the attention of a public that is perhaps not trained to discriminate one from the other. All opinions, regardless of their epistemological status, coexist in the same horizontal space. This is the zone of competition in which PCST is inserted in social networks.

As Tik Tok is a predominantly visual network with short contents, the possibility provided by the channel to deal extensively with complex topics or to be able to articulate arguments that propose more than the presentation of a few simple premises must be considered.

In short, the conditions of production and recognition provided by Tik Tok seem to hinder the possibilities for a meaningful PCST. Nevertheless, we consider that the dissemination practices in this social network present not only considerable, but also valuable specificities. One of the objectives of this paper is to elucidate these particularities of PCST in Tik Tok, among which we highlight the facilitation of scientific-public engagement as a result of the horizontality required by this type of discursive interactions.

2. Methodology

The parameters of this qualitative analysis are oriented around the argumentative discourse and involve a hybrid proposal between the criteria of the scientific documentary formulated by Bienvenido León (2010), the mediation conditions of Eliseo Verón (1998) and the expertise in public communication of science and technology of the authors of the work (Muñoz Gallego et al., 2022; Rodríguez & Giri, 2021; Nahabedian, 2019).

Based on the proposed approach, three parameters of analysis have been constructed that propose to fulfill the descriptive and exploratory study of the audiovisual scientific content in Tik Tok regardless of its narrative method or length. To this end, the methodological proposal presents an exploration of 1) the communicative dimensions of the Tik Tok profile based on the prospecting and tracking of the contents; 2) the narratological characteristics and resources such as the narrator's position, the mode of representation, the explicit factors of interest and the level of scientific simplification; and, finally, 3) the mediation process and the rhetorical aspects shaped by the role adopted by the scientific disseminators, the discursive method and the articulation of the reading contract.










In order to identify the appropriate and representative audiovisual universe for the study, a SmallData survey was carried out on the Tik Tok social network through the presence - both in the hashtags and in the name of the profile - of search concepts that predominate in the scientific dissemination channels with the greatest media impact. The search terms used in the methodological prospection were the hashtags with the highest presence in the main scientific communication channels of Tik Tok. Suffice it to mention terms such as #science, #sciencedissemination, #ciencia, #sciencetok, #divulgacioncientifica, #learnontiktok, #aprendeciencia, #curiosidadesciencia or #sciencecuriosities. The aim of the study was not to influence the composition of the sample based on the choice of certain scientific disciplines; a priori, any popularisation channel, regardless of the area of study it deals with, could form part of the corpus to be analysed. As a result, ten channels were defined that worked on scientific content, fulfilled the status of *verified profile* and accumulated more than one million subscribers. Using the Google Sort for TikTok tool, the twenty most viewed audiovisual creations per profile were sorted and selected, resulting in a total of two hundred audiovisual productions analysed.

3. Results and discussion

3.1. Communicative dimensions of the profile

The prospection carried out through the aforementioned methodological design has provided the selection of ten profiles in three languages -five in English, four in Spanish and one in Italian. Furthermore, after applying the selection criteria, it was observed that the channels focus on well-defined domains of disciplinary interest, generally in the natural sciences, such as astronomy, biology, chemistry and physics. Channels such as @geopop, exceptionally, work on more varied scientific-technological issues including topics of relevance to the social sciences. Table 1 shows the number of subscribers and the profile description of each of the channels.

Table 1. Selection of Tik Tok profiles

Profile	Subscribers	Description
@sciencechannel	6.4 M	For the love of science
@nilered	10.7M	Capturing the natural beauty of chemistry
@sciencewithana	3.1M	Divulgadora científica Ingeniera química
@katvoltage.mx	1.8M	1ra mujer  en el Espacio
@geopop	1.5M	Le Scienze nella vita di tutti i giorni
@neildegassetyson	5M	Host of StarTalk
@doctorfision	4.1M	 Ciencia, tecnología y curiosidades 
@mikephy	3.1M	Ciencia con lenguaje cotidiano, entendible y divertido 
@asapsience	1.1M	making science make sense   
@astro_alexandra	2.1M	 Space Communicator 

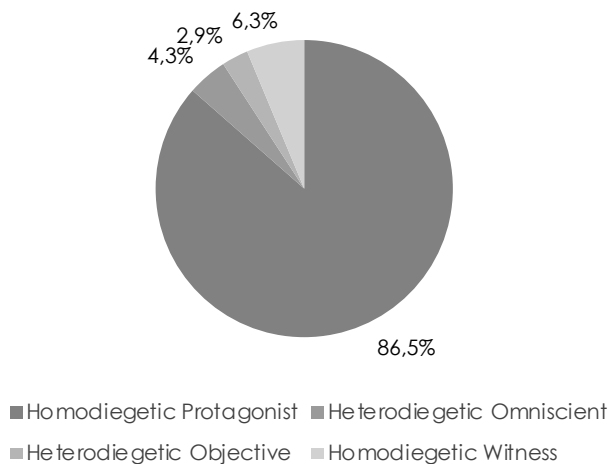
Source: own elaboration

3.2. Narratological characteristics and resources

3.2.1. Position of the narrator: farewell to omniscient science

Defining the position of the narrator in audiovisual products presents some degree of additional complexity with respect to the written text. Nevertheless, the analysis of the material has allowed us not only to identify a dominant diegetic modality in each video, but also to discover a conclusive tendency towards homodiegetic discourse: in 92.8% of the units that make up the sample, the main voice shares the space where what is being told or explained takes place. Moreover, in 86.5% of the videos analysed, it is the narrator himself who is the protagonist of the story, which makes the category of the "homodiegetic protagonist" narrator the most clearly predominant category among all the narratological resources used by popular science in Tik Tok. Another 6.3% of the videos, on the other hand, present a homodiegetic witness narrator, who shares the space, but "from outside" the events.

Figure 1: Position of the narrator



Source: own elaboration

Diegesis is the position of the narrator with respect to the space and time in which the events and actions are presented (Muñoz Gallego & Quintino, 2022). This position can be defined as internal (homodiegetic narrator) or external (heterodiegetic), in which case it can be the classic figure of the

omniscient narrator, or an objective heterodiegetic narrator, if his or her point of view is limited to the spatio-temporal situation of the story.

Heterodiegetic narration was limited to just 7.2% of the analysed material, shared between the "omniscient" and "objective" categories, indicating that the figure of science as an omniscient or purely objective and fleshless subject has very little place in Tik Tok. This - and the dominance of the homodiegetic narrator - seems consistent with the already seen objectives of science-audience engagement.

That being said, it should be noted that this analysis focused on interpreting "the voice of science" within the framework of the narrative complexity of audiovisual genres in general and social networks in particular. Any popular science product involves a multiplicity of levels (the medium, the device, the editing, the production, the script, the sources of information, etc.) among which the final product may be no more than a particular cut, a sample. In the series of videos of underwater exploration seen on @sciencechannel (a channel where a quality of production more typical of television documentaries than networks is evident), each unit is a fragment where the position of the narrator varies with respect to other elements of the series, without losing the homogeneity of the story.

In other cases, polyphony is introduced by interjecting fragments of interviews (see 4.3.1), without the narrator losing his homodiegetic character. As for the heterodiegetic narrator, it is frequently found when the story unfolds as a written text, or even as a brand of advertising genre (as in a strange video comparing flamethrower models in @geopop).

It is important to clarify that our observation focused on the diegetic character of the narrative as a central resource for the presentation of scientific or technological content, and, in this context, we sought to identify the predominant resource. The evidence of montage operations or the addition of background music present in several of the videos with a homodiegetic narrator, could lead us to classify the material as "heterodiegetic", as they show narrative interventions "outside" the space of the "facts". However, we have not observed cases in which the music or the montage itself added value to the significant dimension of the material beyond an aesthetic function, so they were considered secondary for the purposes of this study. We can say, then, that the resource of the narrator-protagonist in Tik Tok coexists and amalgamates with heterodiegetic operations as long as these operations have only an aesthetic function.

3.2.2. Mode of representation: monologues, in spite of everything

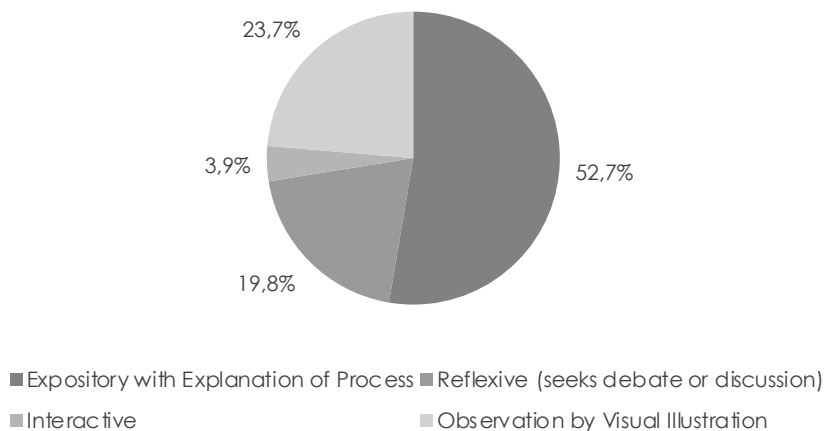
Given that Scientific Literacy and the PUS paradigm have conceived PCST as a vehicle for the transmission of scientific and technological knowledge to the public, the explanation and exposition of concepts and objects that are part of this "knowledge" of specialists is a central part of the popularisation genre. With this in mind, we oriented the analysis of the material towards the recognition of ways of representing knowledge. To this end, we recovered the categorisation used by León et al (2010), derived in turn from the ideas of Nichols (1997), and adapted them for the purposes of this research. Following this characterisation, we chose *the explanatory exposition of processes and concepts and visual illustration* as the main modes of representation. To these resources we also added *interaction with the spectator* as a basic resource to be expected in engagement strategies, and *reflection*, that is, *the search for debate or discussion* as another possible alternative for controversial issues on the public agenda.

When analysing which of the above is the predominant resource in each video, we found a clear dominance of the first (explanatory with explanation of processes) with 52.7%. Very close in the second and third place, they follow the representation through visual illustration, where it is preferred to exploit the technical resource of the image (23.7%), and the search for content that promotes debate, reflection or discussion (19.8%), often with current affairs as the main attraction (see 4.2.3).

Our classification focuses on the main mode of representation of each video, privileging the expository with explanation of processes. In some of the videos, it is not easy to identify the main feature, especially when the explanatory aspect is articulated with visual appeal, in which case we understand that the explanation -that is, the knowledge made explicit through language- is the main resource. Only when the image prevails over conceptualisation or linguistic construction, is the material considered as being based on the resource of visual illustration.

Following this last point, it should be noted that, although the resource of appealing directly to the audience appears in only 3.9% of the sample, in several videos there are both polyphonic retakes (allusions to user comments in previous pieces) and directive forms of a conative nature (instructional texts that expect an extraverbal attitude from the receiver). However, as what prevails is a monologic tendency that places the scientist-mediator at the centre of the pedagogical link, these dialogic components are presented as secondary, which results in their lower presence in our graph.

Figure 2: Mode of representation



Source: own elaboration

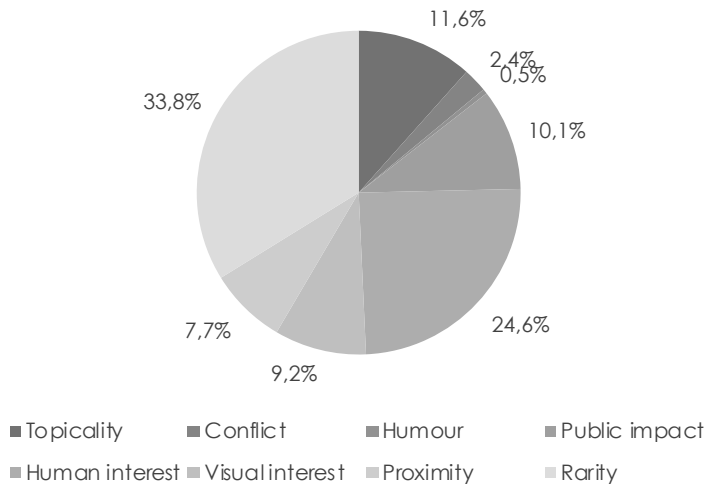
It is worth noting that the expository nature with explanation of processes does not guarantee that scientific concepts are clarified or explained in the video. The @nilered channel shows and describes colourful chemical reactions and processes live, but in general without explaining why they occur or ever mentioning concepts such as "Periodic Table". @sciencechannel resorts to scientific explanation by appealing to multiple resources, but it also has videos that aimed at causing impact, intrigue or even displeasure without any scientific or technical explanation whatsoever. @neildegrassetyson is another channel where its famous protagonist, on many occasions, makes jocular comments seeking the complicity of his audience, without any strictly scientific content surfacing. @sciencewithana, on the other hand, makes instructional videos indicating the steps to follow to make homemade toys "with a bit of science" (slime, rudimentary fire extinguishers, 3D drawings) but with little or no explanation of the chemical phenomena involved in the process. In short, neither the clear predominance of the resource of exposition with explanation of processes nor the possibility of illustrating the "facts" with objective images guarantee the fulfilment of the objectives that the ideology of Scientific Literacy and its related currents propose as the core of scientific popularisation: to disseminate knowledge and promote rational thinking based on facts. Although, of course, nothing detracts from the fact that Tik Tok does indeed have this potential.

3.2.3. Explicit factors of interest: we are interested in the weirdness of science

The purpose of this section is to analyse the explicit factors of interest that are perceived in scientific audiovisual narratives and that are decisive for retaining the attention of the potential viewer on the scientific topic. In order to discern why scientific content would be relevant for the audience, we have defined parameters such as topicality of the topic, the generation of conflict, the public impact, the human interest, the proximity to the scientific issue, the rarity of the subject or the visual interest as unique features of scientific content.

In this sense, the evaluation of the cases defines how the explicit factors of interest can be divided into two clearly differentiated levels. At the first level of incidence, rarity (33.8%) and human interest (24.6%) are identified as the characteristic features most frequently used by creators of scientific content on the social network Tik Tok. Strange phenomena, the uncommon, the exceptional or what is on the frontier of human knowledge are an incentive to attract and retain the audience. This is the case in @sciencechannel, where the story is told from inside an underwater capsule, through which scientists - at the same time as their audience - observe the phenomena of the seabed. On the other hand, human interest is related to our natural curiosity and the role of science in understanding the world around us. Ultimately, we are drawn to learn about ourselves and how we fit into the world.

Figure 3: Explicit factors of interest



Source: own elaboration

In second place, and in order of incidence, they appear current affairs (11.6%), public impact (10.1%), visual interest (9.2%) and, lastly, proximity (7.7%). In this context, it is important to identify how science communicators play an important role in contrasting, denying or justifying current scientific news or hoaxes. Suffice it to mention the figure of the physicist communicator @doctorfision, who dedicates part of his content to clarifying pretentious scientific headlines that can generate confusion among audiences. On the other hand, the aesthetics inherent in many natural phenomena and scientific structures to which only scientists or research organisations have access generate visual interest. For example, @nilered's channel is interesting not only for the visual richness of its experiments, but also for the careful execution of its images. Furthermore, audiences are aware that scientific advances often have direct implications for our lives and that their knowledge helps us in our decision-making, so it becomes an explicit element of interest.

Finally, it should be mentioned that narratives with a focus on conflict and humour are the explicit factors of interest that least encourage the consumption of scientific content. Examples of channels such as @asapscience use humour, which leads to a high simplification of scientific content.

3.2.4. Level of simplification: seeing is believing

In order to construct a more accessible and comprehensible discourse, the scientific message begins a process of mediatisation in such a way that it abandons the scientific statement and adopts the rules and grammars of the media. This process of simplification (Muñoz Gallego & Jiménez, 2021) involves avoiding complex concepts and technical terminology that dissuade users from scientific consumption, which is why it is essential to implement discursive strategies to recontextualise scientific narratives.

The results of the analysis in this section are difficult to categorise because of the different methods available in the narrative universe. However, examination of the case studies in Tik Tok reveals a clear trend of simplification through the presentation of scientific concepts by ostension (72%), i.e. using tangible display or direct experience to illustrate the scientific concept. Presentation by ostension can be particularly effective in areas of science that rely on observation, such as biology, physics or geology. By showing concrete examples, practical experiments or real phenomena, a more concrete experience is provided, which facilitates understanding and an emotional connection to the scientific concept presented. For this purpose, it makes sense that a characteristically visual social network bases its narrative methods on direct observation of real scientific objects or phenomena.

Figure 4: Level of simplification



Source: own elaboration from @mikephy's channel

At a second level, although at a very significant distance, the use of analogies or simplified models predominates. The use of similes makes it possible to establish a connection between an abstract scientific concept and something more familiar or of everyday life to the user. By relating the new concept to something that is already known, understanding is facilitated for those who do not have specialised scientific knowledge. As we have seen in the previous section (see 4.2.3), analogies often involve mental images or visual representations that help recipients to better visualise and understand scientific concepts. As an example, the channel of the young Mexican @mikephy starts videos with questions about everyday life or pop culture phenomena that he explains with scientific theories or processes through the use of metaphors (see Fig. 4).

The communicative tendency of Tik Tok has a reduced acceptance of explicit definitions (6.8%) or the interrelation between scientific concepts (3.9%), as well as the presentation of concepts by reformulation (4.8%), which may offer a lower degree of ostension. Finally, the residual results of the analysis refer to content promoting the channels where specific scientific content is published, but which do not show a process of narrative simplification.

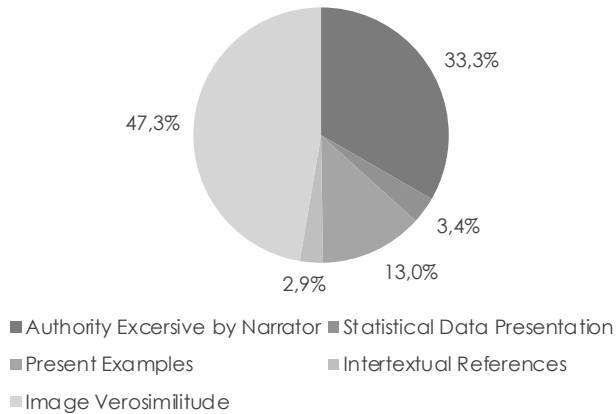
3.3. Mediation process and rhetorical aspects

3.3.1 Rhetorical aspects: persuading to explain

Rhetorical resources are understood as those discursive means aimed at persuasion, which is why they are usually traced in genres that are predominantly argumentative in nature (opinion articles, essays, pamphlets, debates, etc.). However, a wide range of studies ranging from discourse analysis (Maingueneau, 2002) to semantic-pragmatic linguistics (Anscombe & Ducrot, 1983) recognise the argumentative condition inherent in all enunciative acts. This kind of "pan-argumentative" conception enables an exploration of the rhetorical aspects involved in texts which, at least at first sight, would not correspond to what tends to be understood as argumentative genres. In the case of PCST, the predominantly explanatory or informative condition is coupled with persuasive aims oriented towards the promotion of a scientific understanding of the phenomena of the world and the recognition of scientific authority.

Following León *et al* (2010), the rhetorical techniques traced in this paper are the authority exercised by the narrator, the verisimilitude of the images, the presentation of statistical data and the presentation of examples. In order to see these parameters, we add intertextual references (which would include *ad verecundiam* arguments).

Figure 5: Rhetorical aspects



Source: own elaboration

In one third of the sample collected, the main rhetorical means identified was the narrator's authority, that is, the display of subjective conditions that would serve as guarantees of what was said, for example, when referring to the narrators' status as scientists. It should be clarified that this operation is carried out in different ways by the profiles analysed. It can be done explicitly, for example, when the narrator presents herself as a scientist by mentioning her accreditations or fields of work. This is the case of the self-presentations of @katvoltage.mx, who recalls that she is an electronics engineer and works at NASA. In many cases, the profile data did not provide information about the credentials that would qualify them as spokespersons for science. On the contrary, authority seemed to be constructed from visual elements that make up the stereotype of the scientist and that would lead to recognising the homodiegetic narrators as such (smocks, libraries, laboratory instruments).

The predominance of the verisimilitude of the image as a source of persuasion (47.3%) may be due to the pre-eminently visual nature of Tik Tok. Verbal explanation tends to be complemented, if not supplanted, by visual resources that give an account of the actual occurrence of a phenomenon (laboratory experience, documentary record) or event (journey into space by a tiktokker). Moreover, unlike other genres in which verbal argumentation is central, the exploitation of the pathemic power of the image must be understood as part of the grammar of Tik Tok video production.

Strikingly, intertextual references and statistical data are infrequently used (2.9% and 3.4% respectively). There have been warnings elsewhere about the risks of this type of production of presenting science as an individual enterprise and hiding its collaborative aspects (Zeng, Schäfer & Allgaier, 2020). Intertextual references, probably because they are considered to unnecessarily complicate the exposition, are avoided in the videos, and, when they are mentioned, they are generally vague ("studies have shown that..."). This scarce presence of polyphonic outlines, which would give an account of knowledge as the product of joint work, means that the narrator is obliged to act as the support that guarantees the scientific status of the statements. Hence the importance of the mediation processes that institute relational links between the enunciators and the enunciatees of the videos.

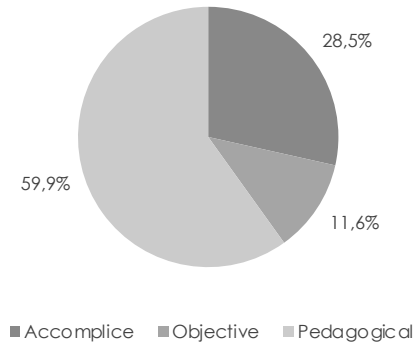
3.3.2 Mediation processes - the reading contract: variations on the pedagogical asymmetry

The rhetorical aspects also include the discursive ethos, i.e. the image of the speaker constructed on the basis of the subjective impression generated by the enunciative act (Amossy, 2010). This source of persuasion serves as a guarantor of PCST where scientific data is skimmed or the argument is inconclusive (Nahabedian, 2019). Ultimately, it is the construction of trustworthiness that is vital for establishing the didactic link. This is a strongly bonding aspect associated with the process of mediation between an audience and the object that is given to them to understand.

Eliseo Verón, when proposing a methodology for discourse analysis that is attentive to enunciative strategies, defined the term "reading contract". In the case of the written press analysed by Verón (1985; 2004), the media construct, through their reading contracts, the type of relationship they will have with their readers based on the selection of an "enunciation device". The enunciation device is made up of the image of the person who produces the discourse (enunciator), the image of the person for whom it is intended (addressee) and the type of relationship between the two subjects. Based on this definition, the author typifies, without being exhaustive, three reading contracts adopted by the graphic press: the objective contract, for cases of enunciative distancing and impersonalisation

of the enunciators; the pedagogical contract, in which the enunciator proposes herself as an agent of knowledge for an audience that must be guided; and the complicit contract that initiates an inter-peer bond of complicity that is constructed by means of the appeal to, among other things, discursive memories and common cultural consumption (Verón, 2004).

Figure 6: Reading contract



Source: own elaboration

In this work, we recovered Verón's typification to find that the predominant enunciative contract in our analysis material is the pedagogical one (59.9%). Explanatory texts tend to construct this enunciative scene, often given a priori as a generic feature. However, this pedagogical expert/lego link is variable in its asymmetry. Although the explanation forces the construction of the subjective poles of the one who knows and the one who has to be taught, some videos soften these differences by tending towards less vertical interpellations.

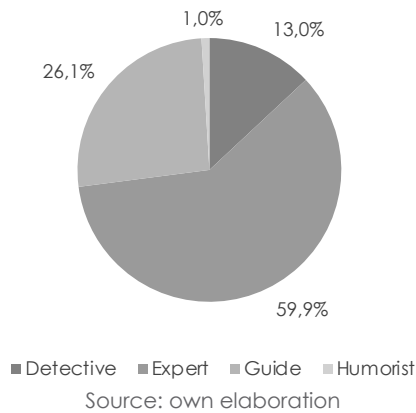
A considerable portion of the graph is occupied by the accomplice contract (28.5%). Coincidentally with the hypotheses when planning, social networks and especially Tik Tok work primarily on the relational dimension of PCST. It is understood that making a scientist accessible would have the immediate correlate of making science accessible (Nahabedian, 2019) or, in other words, engagement should no longer be thought of as between science and the public, but between the scientist and the public. Complicit contracts are built on the imaginary of accessibility and the democratising expectation that anyone could become a scientist (generally with just personal effort, curiosity and imagination). The case of @asapsience is illustrative. Humour and choreography slip in between frankly explanatory and erudite videos. Entertainment and learning emanate from the same channel and the same subjects, making scientific culture and pop culture coexist in the same space and at the same time. In this way, certain representations of the person of science and her role are contributed to the conditions in which the processes of mediation take place.

3.3.3 Mediation process - role of the scientist/disseminator: between experts and friends

For the analysis of this parameter, it should be noted that in all cases in which the narrator appeared in front of the camera (homodiegetic), she played the role of the scientist. In most cases, we were not led through the explanation by a curious but uninformed mediator, who had to consult scientific experts in order to acquire knowledge, but rather the acting roles of the mediator and the scientist were absorbed by the same agent (Calsamiglia & Cassany, 2001). This is notable in that the "expert" is the main role adopted (59.9%). Coinciding with the predominance of the pedagogical linking contract, the scientist is constructed as the holder of the knowledge or the methods to find the answer.

The cases in which the representation of the scientist took the form of the "guide" (26.1%) are those in which the scientist is projected as a role model. Many of the videos aim to "humanise" science, to produce a bond of parity between the scientist and the public ("you could be here"). The verbal, visual and auditory pathemic discursive resources (musicalisation) tend to construct the representation of a scientist emotionally involved with her work or with her object of study.

Figure 7: Role of the scientist



One observation that emerges from the corpus is that in many cases science functions as a means of empowerment. The scientific field is shown as a space to be conquered for the recognition of the contemporary repositioning of women and sexual diversities. The stereotype of the white, adult, male scientist is twisted in favour of identifying diversities in the order of the imaginary. However, and returning to what was said above, the narrative often constructed on the basis of the script of personal achievement or the exceptional hero runs the risk of presenting these conquests as individual achievements in the face of adversity and not as an indicator of a historical and social process. Nevertheless, the representational possibilities provided by social networks construct science as a desirable space, from which not only more and better knowledge about reality can be gained, but also from which subaltern identity collectives can be made visible.

The place of pop culture in tiktok production and in the construction of the ethos of the scientist is noteworthy. Allusions to Hollywood productions or mentions of pop artists are frequent, reinforcing the binding function of networks for PCST. "Cultured" consumption gives way to the mundane pleasures of the symbolic consumer society of North American descent. Star Wars T-shirts, anecdotes with Lady Gaga, comic book superheroes and pop songs are not introduced as alien to the identity of the science person, but as a constitutive part of what it is to be a scientist today. Intertextual allusions to the pop discursive universe help to construct the scientist-mediator's affability by reinforcing the enunciative effect "I am like you".

4. Conclusion

Throughout this paper we have analysed a corpus of 200 videos from 20 PCST channels on the social network Tik Tok in order to explore their capacities and limits for the effective dissemination of scientific-technological knowledge. From the analytical treatment of the audiovisual material, we came up with a working method that, initially organised around a quantitative approach with no pretensions of exhaustiveness, was combined with a qualitative perspective nourished by already proven study categories (León *et al.*, 2010; Muñoz Gallego *et al.*, 2023). Likewise, other enunciative and rhetorical parameters were explored for the study of discursivity in social networks.

We will now present our conclusions:

Given the permeability of Tik Tok in the under-24 age group, it is necessary to use it to disseminate scientific and technological content. In this sense, it should be clarified that the usual format of Tik Tok contents (videos of approximately one minute, although longer videos may eventually exist) makes it difficult, but not impossible, to rigorously transmit the most abstract or complex contents of science and technology. However, the task of the PCST is not only to transmit this type of content. Sometimes, it is enough to disseminate some content that clarifies certain concepts that for some reason of public interest are relevant to address, or sometimes it is simply necessary to implement a strategy to consolidate the worldview and methods of science in the population. The homodiegetic protagonist format, in fact, reinforces the latter task, as it replaces a classic conception of science documentaries with voice-overs - in the style of BBC documentaries with Richard Attenborough - that present an omniscient science, with a science that is human and within the reach of all those who are interested in it. The relaxed styles and pop aesthetics of the presenters - in addition to the enormous level of simplification, the predominantly pedagogical approach and the ostensive style of presentation of the content - emphasise this point, and deepen the effectiveness in achieving the engagement so dear to the PES paradigm.

In short, although the very short tiktok format is not ideal for the rigorous transmission of scientific and technological information, its capacity to entertain and surprise in short bursts can be -and in fact is- used to highlight the more human dimension of science and technology and, in this way, to encourage scientific vocations. In this sense, sometimes a one-minute video of a scientific tiktok dancer dancing to pop music can be more effective than a rigorous two-hour documentary, as long as we adjust the criterion of effectiveness in favour of the relational aspects of the expert/laymen contact. From this, it can be affirmed that one effect of tiktok narratives is the reinforcement of scientific authority in times when its stereotypical representation is undergoing a transformation.

Having established the above point, it is also worth mentioning that some tiktokers are creative enough to offer very short videos that still manage to effectively communicate certain content that can serve to inform relevant issues, influence public opinion on certain points and leave an image of science and technology in line with the objectives of the PCST in a broad sense.

Briefly, the corollary of our research is that, although Tik Tok is not an ideal format for PCST, its great power of penetration and its ability to communicate in a short time should be exploited to the maximum, preferably in combination with other media (e.g., offering links from Tik Tok itself to other platforms, such as YouTube or blogs or to the scientific articles themselves). In this way, the engagement generated could be used to encourage the audience to continue exploring more informative and rigorous content on the topics to be communicated. In short, we cannot rely on the autonomy of one social network for the success of a PCST strategy, but rather on the coordinated work of various social networks with their specific communicational characteristics. In this sense, the potential of this social network for an effective and comprehensive strategy for PCST policies cannot be underestimated.

5. Contributions

Contributions	Authors
Conceptualisation	Autor 1
Data curation	Author 1 and 2
Formal analysis	Author 1 and 2
Fundraising	Author 1
Research	Author 1 and 2
Methodology	Author 3 and 4
Project management	Author 1 and 2
Resources	Author 3 and 4
Software	Author 1 and 2
Monitoring	Author 2
Visualisation	Author 1
Writing - original draft	Author 1 and 2
Writing - proofreading and editing	Author 1, 2, 3 and 4

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Translator of the article into English: María Inés Gadea (registration number 7106).

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8. Declaration of conflict of interest

The authors declare that there is no conflict of interest.

9. Declaración responsable de uso de Inteligencia Artificial

No se han utilizado herramientas de Inteligencia Artificial para este texto.

10. Additional materials

The permanent URL of the database is TIKTOK_PERFILES.xlsx

The permanent URL of the questionnaire used is https://docs.google.com/forms/d/e/1FAIpQLSf6l1wGfU2PJPccPzu_nl3L_ecc3iYIOzhK39qOy6Tp_6kLvg/viewform

Another URL with additional materials derived from the article I want to share <https://docs.google.com/forms/d/1Tm5zc9kLPcDzXglF2SJ93XIOhOV-qrTe7-jE2zE2BW4/edit#responses>

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