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SCIENCE DISSEMINATION ON INSTAGRAM: THE CHALLENGE OF SCIENTIFIC AUDIOVISUAL DISCOURSE IN THE FACE OF EPHEMERAL CONTENT

LA DIVULGACIÓN CIENTÍFICA EN INSTAGRAM: EL RETO DEL DISCURSO AUDIOVISUAL CIENTÍFICO ANTE LOS CONTENIDOS EFÍMEROS

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ABSTRACT

The dissemination of science, due to its complex nature, is a difficult task for most audiovisual genres. This challenge is even bigger when the dissemination channel is a social network, with messages requiring brevity and speed. Instagram has become the main source of audiovisual consumption for the youngest audiences, whereas the construction of its contents differs more and more from scientific language. In light of this, we pose the following questions: How do we transform the scientific discourse to adapt it to Instagram consumption trends? What narrative elements ensure media effectiveness? Where lies the undiscovered balance needed to achieve success in science dissemination? To clarify those questions, we analyzed the discourse elements of the most popular Spanish science communication audiovisual productions on the Instagram social network. Preliminary results identify that artistic merit in the use of audiovisual narrative mechanisms and a defined role as a scientific profile encourage understanding between science and younger audiences.

Keywords: dissemination, Instagram, audiovisual, science, youth, communication, narrative, social media, discourse.

RESUMEN

La divulgación de la ciencia, por la complejidad de su naturaleza, se presenta como una cuestión de difícil abordaje para la mayoría de los géneros audiovisuales. Sin

embargo, este desafío se acrecienta cuando el canal de difusión es una red social y sus mensajes exigen brevedad y rapidez. Instagram se ha convertido en la principal fuente de consumo audiovisual para los públicos más jóvenes y la construcción de sus contenidos difiere cada día más del lenguaje científico. Con este propósito, nos planteamos las siguientes preguntas: ¿cómo transformamos el discurso científico para adaptarlo a las tendencias de consumo de Instagram?; ¿Qué elementos narrativos procuran la eficacia mediática?; ¿Dónde se encuentra el equilibrio para alcanzar el éxito divulgativo? Con la pretensión de esclarecer las siguientes cuestiones se analizan los elementos del discurso de las producciones audiovisuales de comunicación científica españolas de mayor repercusión en la red social de Instagram. Los resultados preliminares identifican que el mérito artístico en la utilización de mecanismos narrativos audiovisuales y un rol definido como perfil científico favorecen el entendimiento entre la ciencia y el público más joven.

Palabras clave: divulgación, Instagram, audiovisual, ciencia, jóvenes, comunicación, narrativa, redes sociales, discurso.

DIVULGAÇÃO DA CIÊNCIA NO INSTAGRAM: O DESAFIO DO DISCURSO CIENTÍFICO AUDIOVISUAL DIANTE DE UM CONTEÚDO EFÊMERO

RESUMO

A divulgação da ciência, pela complexidade de sua natureza, apresenta-se como uma questão difícil para a maioria dos gêneros audiovisuais. No entanto, esse desafio aumenta quando o canal de divulgação é uma rede social e suas mensagens exigem agilidade e rapidez. O Instagram tornou-se a principal fonte de consumo audiovisual para o público mais jovem e a construção do seu conteúdo se distancia cada vez mais da linguagem científica. Com esse propósito, colocamos as seguintes questões: como transformamos o discurso científico para adequá-lo às tendências de consumo do Instagram?; Que elementos narrativos buscam efetividade midiática?; Onde está o equilíbrio para alcançar o sucesso informativo? Com o objetivo de esclarecer as seguintes questões, analisam-se os elementos do discurso das produções audiovisuais de comunicação científica espanhola com maior impacto na rede social Instagram. Os resultados preliminares identificam que o mérito artístico no uso de mecanismos narrativos audiovisuais e um papel definido como perfil científico favorecem o entendimento entre a ciência e o público mais jovem.

Palavras chave: divulgação, Instagram, audiovisual, ciência, juventude, comunicação, narrativa, redes sociais, discurso.

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1. INTRODUCTION

Science is the progress of contemporary societies whose results directly affect people's daily lives. However, scientific knowledge is a statement that has a specific and complex language due to its high levels of specification and abstraction. Its methods, whether empirical or experimental, present great difficulties when, at the communicative level, they wish to cross the frontiers of the academic community. Consequently, science and society speak different languages that contribute to citizens

living with their backs turned to scientific and technological advances.

In this context, science popularization seeks to make citizens science literate to better understand and comprehend the world in which we live (Barrio and Rajas, 2021; Burns et al., 2003; León et al., 2010). Communicators, despite the discursive obstacles held by scientific language, encourage and experiment with new formats to attractively disseminate science (Polinario, 2016). Likewise, consumption habits, informative, formative, and entertainment, are transformed daily precipitated by the intensive use of social networks and an increasingly liquid society (Bauman, 2004)¹, so that the discourses evolve towards specific narratives of shorter duration, faster, and simplified.

In the first place, science dissemination should question whether there is real interest among the public in scientific content and, if so, what would be the appropriate channels and formats for the consumption of scientific communication. However, according to surveys on the social perception of science (FECYT, 2020), 14.2% of the Spanish population is interested in science and almost 80% prefer social networks to consult and obtain information on scientific content. The report also shows that young audiences are the most interested and that more than 70% of the Millennial and Z generations² prefer audiovisual materials as a consumption format. These surveys show that the Spanish population between 6 and 40 years of age has a moderate interest in science and that they choose to consume audiovisual formats through social networks to explore science-related content.

All in all, the universe of social networks is increasingly broad and different apps offer new communicative opportunities (Zulli, 2017). According to the Social Networking Study (IAB, 2022), in Spain, 93% of the population is considered to be Internet users, of which 85% are users and consumers of social media through apps. The study highlights that among the multiplicity of tools, Instagram is the most valued social network (8.4 out of 10), which has generated the most interaction among users, where influencers are followed the most, and which receives the greatest advertising investment (IAB, 2022).

As a result, this paper formulates three main research questions: firstly, how scientific language is transformed for its communicative adaptation to the new trends of audiovisual consumption in social networks, specifically, in the Instagram app; secondly, what elements of audiovisual discourse procure the much-prized media effectiveness; and finally, where is the communicative balance to achieve informative success through short formats without losing the rigor of science.

In short, the great problem faced by science popularization lies in the increasing distance between science knowledge and society, even more so in a communicative context of infoxication (Polinario, 2016) and misinformation (Ryan et al., 2020). Likewise, thanks to the "diversity and plurality of voices concentrated in social media, academic and research work has consistently shown that such media serve to illustrate

¹ This concept refers to Zygmunt Bauman's (2004) "liquid modernity" characterized by the lack of solid referents and the instantaneousness of problems and results.

² The Millennial generation is made up of people born between 1981 and 1996 and the Z generation is made up of those born between 1997 and 2015.

and show a broad view of our social world" (Cantón-Correa, 2019, p. 26). In line with the exposed problem, the following research seeks to address the most convenient communicative configurations to adapt science to the new forms of consumption of social networks and consequently narrow the gap between science and society.

1.1. The discourse of scientific dissemination

To address the imbalance between science and common knowledge, Bienvenido León (2001) mentions that "to solve this distance it is necessary to build a peculiar discourse time, in which scientific knowledge is submerged in a process of transformation that adjusts it to the audience's modes of understanding" (2001, p. 8). This definition leads us to one of the main characteristics of scientific communication, the transformation of the message, in other words, how and in what way the scientific text should be modified so that the common knowledge audience can attractively and understandably receive it.

In this context, this process becomes a "language translation" at the communicative level that circulates from point A in the form of scientific discourse, such as an academic article, to point B as a divulgation discourse, which could refer to a short Instagram video. Some authors refer to the translation process as a "recontextualization" of the experts' message to make it understandable to a global audience (Salcedo, 2010, p. 36). However, this is not an impoverishment of language to cater to the "average audience" according to the logic of the mass media but a complex exercise of the "double epistemological rupture" (Villela and Almeida, 2013). In the first rupture, common sense is broken to constitute science and in the second rupture, the one carried out by dissemination, the challenge is to contribute to the common sense of society based on science through communication.

To achieve the transition to dissemination, the scientific text is subjected to a simplification of the message. This process is necessary due to the very nature of the fields of science and the media. Firstly, scientific language provides a large amount of detailed information, through empirical methods and a multitude of data that appeal to reason (León et al., 2010). On the other hand, the language of the media is light, uses general information in an attempt to convey one or two ideas, and strives to appeal to emotions. Consequently, simplification, despite the fear felt by many researchers, is an inevitable and imperative process to achieve the discursive effectiveness of the informative message (Muñoz and Jiménez, 2021). In this way, scientific content begins a phase of mediatization and abandons the rules of the discourse of the field of science to adopt the rules and grammar of enunciation of the media field (Hjarvard, 2008).

However, the transformation of the discourse must satisfy both the source and the receiver of the message. On the one hand, the scientist will feel how their discourse is streamlined, being freed from uncommon technicalities and processes of complex comprehension but without noticeably affecting the scientific rigor of the text. On the other hand, the receiving source of the scientific content, the audience, wants to know to what extent the scientific content affects them in their daily lives through accessible language without encountering points of incomprehension that cause a loss of interest (Polinario, 2016). Therefore, for the result of dissemination to be satisfactory during

the process of recontextualization of the discourse, there must be a balance that maintains scientific rigor (León et al., 2010) and that becomes the great difficulty of science dissemination: the achievement of scientific balance and its adaptability to the discursive logics of the channel where the dissemination is intended to be carried out.

Accordingly, there are specific characteristics of the message that can help to achieve better acceptance by the public. First, the scientific discourse must generate a bond of interest, that is, a type of "reading contract" (Veron, 1997) with the receiver so that the viewer perceives that the content directly affects their daily interest. Secondly, although many scientists consider it inappropriate, the communicator tries to find certain sensationalism by referring to the extraordinary or the bizarre as a favorable ingredient to disseminate the scientific discourse (León, 2001). This resource on the "unusual" in science can prove to be a strong ally to capture the attention of the audience, as long as it does not imply action to the detriment of the scientific content.

In short, regardless of the textual approach contained in the scientific message, the great challenge for the communicator or producer will be to achieve the most appropriate construction of the audiovisual discourse together with other narrative-rhetorical tools (León et al., 2010) to make the message attractive and interesting for the viewer. As mentioned by the researcher in public communication of science, José Manuel Azevedo, "despite how respectable the public dissemination of a scientific subject may be, unless its visual treatment is interesting, relevant, and entertaining, the audience will not decide to watch it" (León et al., 2010, p. 98).

1.2. Obstacles to the scientific message

Already at the end of the 1980s, Stephen W. Hawking, in his Prince of Asturias Award speech, pointed out that every democratic society needs a scientific base that will enable them to be informed citizens, capable of expressing their opinions, intervening, and deciding on those issues that affect them daily and on global problems. The power of choice, the development of a critical sense, and being aware of what surrounds us as active beings drive us toward the knowledge society and move us away from the information society as passive beings of the communicative system because "knowing how to choose is the key that defines the knowledge society" (Hawking, 1989).

In short, it seems that the importance and inefficiency of popularizing science is a historical concern and that, even today, the right equation has not been found to introduce science subjects to the media agenda. A large part of this problem has its origin in the fact that science has additional communicative difficulties compared to the common topics that are consumed in the media. As Sergio Álvarez (2021) points out, scientific content is one of the first victims of information saturation and one of the last in line for public visibility.

According to the Cotec Foundation's manual on Communicating Science (2006), there are four major media difficulties for the dissemination of scientific subjects:

First, it is worth mentioning that science is born of abstraction, i.e., it tries to eliminate singularities to get to the basis of phenomena and thus perceive other behaviors. However, "to penetrate these depths when we live immersed in the culture of the

superficiality of external signs, demands from our mind a special effort without which we cannot reach the substance and nature of scientific proposals" (Cotec Foundation, 2006, p. 59). Today, in liquid modernity (Bauman, 2004) and the face of over-information, we live in an economy of attention (Zulli, 2017) and it is increasingly difficult to stop and dedicate an interval of interest to scientific content.

The second obstacle concerns the differences between the language used in science and common knowledge. Depending on the branch of knowledge, languages vary in multiple directions. The Social Sciences and Humanities comprise textual codes close to a common language. However, the experimental or health sciences formulate their laws using complex methods, such as mathematics, physics, or chemistry and require audience training to understand their meaning.

Thirdly, we find the ladder effect: "one cannot reach the highest rungs without first having climbed the first ones" (Cotec Foundation, 2006, p. 60). In other words, for the audience to come to understand the relevance of a scientific event, one must start from a broad and well-known general perspective, so that questions and arguments are generated that guide the viewer to the scientific finding or discovery (Polinario, 2016).

Finally, the Cotec Foundation manual mentions that science "is developing much faster than its assimilation by citizens and the existing gap between discoveries and their transfer to popular culture, far from diminishing, is becoming deeper every day" (Cotec Foundation, 2006, p. 61). In this sense, it should be noted that the implementation of the necessary measures to promote scientific dissemination should be imminent and constant in the media agenda. It is necessary to create a solid scientific base in contemporary societies, from which to assume and consume content with a higher level of detail.

1.3. Audiovisual consumption models on Instagram

In the last decade, media consumption models have been vertiginously transformed and social networks have consolidated as fundamental pillars of communication that demand immediacy and participation (Sidorenko et al., 2021). On the one hand, the flexibilization of digital technologies has led to "multiple apps becoming generators of discourses causing an explosion of audiovisual content" (Francés and Peris, 2018, p. 67). On the other hand, the design of various specialized social networks aimed at specific audiences has favored the specialization of increasingly diverse and heterogeneous audiences.

However, one of the greatest alterations regarding consumption models today has been the democratization of access to information (Díaz-Lucena and Mora, 2022). The possibility of having individual, instantaneous, and independent access to a device with Internet access at any time and place precipitates a new paradigm in social routines and behavioral changes linked to the use of mobile apps (Zhao et al., 2016).

In this category, social networks have established themselves as a great ingredient in the transformation of audiovisual consumption models and social relationship patterns. In the IAB report, Isabel Ponde-k defines them as social structures that share a

common interest "relationship or activity through the Internet, where social encounters take place and information consumption preferences are shown through real-time or deferred communication" (IAB, 2022, p. 13).

However, the cosmos of social networks has shown that users are not only interested in interacting but also in being informed and learning from content (Arce-Romeral and Lozano-Blasco, 2021). In Burns et al. texts, science communication is exposed as "the appropriate use of tools, media, activities, and dialogues to produce one or more of the following personal responses to science: awareness, enjoyment, interest, opinion formation, and understanding" (2003, p. 183). Therefore, as a multidirectional communication channel, the trinomial between information, social relationship, and learning makes social networks a relevant tool for the dissemination of scientific content.

In such circumstances and following the example of the media that preceded them, social networks have adapted their morphology and operation to meet the demands of individualistic audiences according to their specialization and type of interest (Perriault, 2008) and the format of the discourses has undergone continuous transformations to simplify the understanding of the message. As a result, shorter and shorter messages are gaining the preference of the audience immersed in varied contents that change in fractions of a second every time the user scrolls the screen and updates their digital timeline.

In this context of evolution, video content has been moving from its more classic formulas to innovative and shorter formats suitable for the new media. The audiovisual genre has been plunged into a process of "invention and experimentation of other forms and potentialities, where it presents a constant reformulation of aesthetic concepts and believes in the constitution of a new way of seeing the world" (Dávila, 2017, p. 155). Likewise, research indicates that the retention of information among younger people is intensified by consuming visually based information (Arceneaux & Dinu, 2018).

In this sense, scientific content, in itself extensive and complex, faces a major challenge: the abbreviated message. The great difficulty of scientific communication, resides today, in how to formulate the divulgation discourse in an audiovisual and brief format carrying out a simplification of the text without losing its scientific rigor.

In the specific case of Instagram, the original idea was to create a kind of "Twitter with images" that became the fastest growing social network in history and in which every day more than 80 million photos and videos are shared among its users, generally young audiences (Cantón-Correa, 2019). A means of communication based on visual interests that generates great attraction because they combine "visual and textual content with its relational nature as a social network" and also allow linking their publications with other social networks (Cantón-Correa, 2019, p. 32).

Instagram was developed with the initial proposal to disseminate still images, however, the change in user behavior and the emergence of competing social networks, led to the insertion of new features, mainly related to the production of audiovisual content. Currently, the app has resources that can be grouped into five functions: Feed, Live,

Direct, Stories, and Reels. In the Feed, the user can post videos, and photos, and also follow the publications of users from other accounts; Live is the resource that transmits live videos and allows users to save them for later publication; Direct allows the exchange of messages between users; Through Instagram Stories, the user can share messages in the form of text, image, or videos up to 15 seconds long, available only for 24 hours. Additionally, you can insert gifs, time-lapses, polls, question boxes, locations, dates, collages, animated effects, and filters that favor retouching the appearance; finally, the Reels function allows recording short videos, up to 90 seconds long, which can be edited with tools similar to those of Tik Tok such as: audio, effects, timer, alignment, and speed (Instagram, 2022).

On Instagram, Spanish scientific profiles manage to capture the interest of the digital community while favoring the transfer of knowledge from universities and research centers to society (Arce-Romeral & Lozano-Blasco, 2021). In this context, the platform is formulated as a really useful tool for the construction of audiovisual messages and their dissemination in the universe of Internet users interested in science, promoting interaction and creating new discussion and learning communities.

1.4. Science audiences in social networks

It is essential to mention that the fundamental factor that differentiates science popularization from other variants of science communication is the typology of its audience. According to the researcher Ordoñez et al. (2015), dissemination functions as a "bridge that allows the citizen to understand the progress of knowledge and science, and thus to partially defeat scientific illiteracy, which constitutes a serious risk for the individual and the social group" (Ordoñez et al., 2015, p. 1). Consequently, when the general public is mentioned, it is located at some point of common knowledge characterized by very varied educational levels and interests. The lack of definition of the audiences to which science communication is addressed implies a loss of orientation on where to start when it comes to directing scientific content.

Specifically, in the case of Instagram, it has been perceived how the trend of science dissemination accounts pursue pedagogical purposes among people in general and young people in particular, with high school and university students being the most widely represented in this social network (Álvarez and Hernández, 2021).

However, there are attempts to catalog science audiences according to different criteria and authors. From the educational perspective, the researcher Luis Pablo Francescutti (2014) elaborates a social sphere according to the level of education of the audiences and their proximity to science, from popular culture amateurs to the scientific community itself.

In the case of researchers, Burns et al. (2003) define scientific communication as a term that encompasses different human groups according to their interests, needs, attitudes, and level of knowledge:

- Scientists: from industry, academia, and government.
- Mediators: communicators, educators, opinion leaders, scientific, educational, and governmental institutions.

- Decision makers. Scientific, educational, and government institutions.
- Attentive public. People that are informed and interested in science.
- Interested public. People who are not necessarily well informed but have an interest in science.
- Rest of the public who do not belong to any of the above categories.

In this context, it seems that reaching a comprehensive catalog that satisfies the questions about the target audience of science communication is complicated, to say the least. However, according to the 2021 Annual Study of Social Networks, the level of education of the public is a key factor in the consumption of social networks. 51% of Internet users of these platforms have university studies, 32% belong to secondary school, and 12% have a postgraduate degree (IAB, 2022). Therefore, the criterion exposed by Francescutti that relates the academic background of the public and its proximity to science can provide more guidance when calculating the level of simplification that should be applied to scientific communication products.

In the case of Instagram, it ranks as the fourth most-used social network by the Spanish population (69%) with 21 million active users, 54% women, and 46% men (We are social, 2021). Regarding ages, 70% of users are young people between 13 and 35 years old (Cantón-Correa, 2019) who show audiovisual consumption habits characterized by speed and who seek to participate, intervene, and interact with the content they view (Francisco-Lens and Rodríguez-Vázquez, 2020).

Social networks can be a great stimulus for students and other audiences to face a more complex and relevant scientific topic (Alamri et al., 2019). Therefore, taking into account the heterogeneous profile of the audience, it is observed that Instagram has become a democratic space for users, celebrities, influencers, companies, and organizations to bring science closer to the younger audience.

2. METHODOLOGY

To achieve the object of study, an analysis of the argumentative discourse of significant cases was carried out based on the methodology of the parameters of the scientific documentary (León et al., 2010):

- Formal characteristics
- Storytelling characteristics
- Narrative techniques
- Dramatic techniques
- Rhetorical techniques
- Mediation process

At the social media level, small data research has been carried out, small-scale examinations with qualitative and quantitative methodologies (Cantón-Correa, 2019).

So, to analyze the study parameters, eighteen significant cases have been identified in Spanish, two cases per profile, among the audiovisual productions of scientific communication with the greatest media impact on the Instagram social network since June 2020. To do this, first, an exploratory search was carried out to select nine profiles with content in science communication that had to meet the following criteria:

- Publish audiovisual pieces on their profile (with a minimum of 5 videos on their profile).
- Present more than fifty publications in the Feed.
- Have more than 10,000 followers characterizing the profile as a micro-influencer.
- Categorization of profiles according to the type of profile (1. Influencer, 2. Organization or institution, and 3. Science group), number of followers, and number of publications.

Secondly, once the profiles were identified, the two videos with the highest number of views were selected according to the following parameters:

- The content of the videos must be scientific.
- They must have been published after June 2020.
- Videos available in the Reels section (vertical format).
- A maximum duration of 2 minutes.
- Videos originally published for the Instagram platform (no watermark from other apps as is often the case with Tik Tok).

Therefore, to answer the questions presented in the research, the analyses presented above were applied to identify the narrative-rhetorical and textual features that characterize the most popular science audiovisuals with the greatest impact on the Instagram social network.

3. RESULTS AND DISCUSSION

Once the methodology was clarified, the analysis of 18 audiovisual works from 9 scientific Instagram profiles, with a maximum duration of one minute, was carried out. The profiles were characterized equally, so that three belonged to influencers, three to groups of scientists, and the last three to scientific or cultural institutions (Table 1). In all the accounts, the offers of audiovisual messages point to a narrative strategy of shorter duration in which the speed and ephemerality of the information transcend the solidity of permanence (Bauman, 2004).

Based on the results obtained, the profiles with the highest number of followers correspond to scientific institutions, such as Nasa or the Prado Museum, closely followed by the profiles of influencers and, thirdly, groups of scientists.

Table 1. *Instagram profiles*

Profile	Description	N.º of followers	Type	No. of publications
@diariodeunacientifica	A science communicator and biotechnologist.	43,7 k	Influencer	70
@santigarciacc	Professor, science communicator, and mathematician.	160 k	Influencer	1.786
@quantumfracture	Physicist and science communicator. Contents about physics.	361 k	Influencer	305
@cosmos.curiosity	Disseminates curious facts about science and astronomy.	49,3 k	Scientists' group	1.983
@somosamautas	Scientific communicators. Contents about astronomy.	51,8 k	Scientists' group	149
@aschemist	Chemist.	14, 9 k	Scientists' group	111
@nasa_es	Profile of NASA governmental organization in Spain.	616 k	Institution	400
@alma.observatory	Profile of ALMA (Atacama Large Millimeter Array) Observatory.	122 k	Institution	1.408
@museoprado	Official profile of the Museo Nacional del Prado.	970 k	Institution	1.209

Source: Own elaboration based on Instagram data.

Apparently, the number of publications does not seem to have a relevant relationship

with the social impact of the profile. Although the institutional accounts are those with the highest number of publications, this may be justified by the fact that many of them have communication teams dedicated exclusively to the company's corporate communication. The strategy of having professional communication teams in the production of audiovisual messages can impact the greater retention of interest by audiences (Arceneaux and Dinu, 2018) and obtain a greater number of followers.

Finally, we should note the importance of the "shtick" or differentiating theme of the Instagram account (Zulli, 2017). This feature establishes the relationship between the content creator and its target audience, so that, the profile acquires a specific personality along with its tone, expressive code, or language with which it addresses its audience (see section 3.7. Communicative characteristics of the profile). Likewise, in the communicative context of infoxication (Polinario, 2016) and disinformation (Ryan et al., 2020), this personality acquired by the profile should be oriented toward the quality and veracity of the information as a differentiating element.

3.1. Formal characteristics. Use of sound, montage, music, titles, and graphics

This section takes into consideration the formal characteristics of the audiovisual pieces and analyzes parameters such as the origin of the image, whether it is original or from an archive. The content, if it is a specially recorded image, if it has been reconstructed, or dramatized. The sound, if it is an off or in narration, if it has ambient sounds, sound effects, or music. And finally, the montage, if it is narrative, ideological, or abstract, or if there is computer graphics printed on the images.

Firstly, from the analysis of the publications, the origin of 61% of the images is an original source, filmed by the protagonists or recorded at the moment of the scientific process, which gives veracity and spontaneity to the sequences. Mainly, on the occasions observed that are from the archive, they are used to represent anomalous situations or those difficult to capture by the camera. The mixed format is uncommon but current images may be compared with older archive material that serves to illustrate advances or earlier moments in the history of science. In short, both strategies try to generate visual interest and approach the audience's way of understanding (León, 2001).

Regarding the content, the image recorded specifically for the creation of the content is the predominant resource. Likewise, in most cases, it maintains its ambient sound, which provides reliability and authenticity to the processes or the scientific narration. In this context, Brown et al. (2019) recommend the exploration of the behind-the-scenes of the scientists' work to provide greater veracity to the film record. On one of the occasions, 2D animation appears as a reconstructed image to expose complex data, however, this resource requires qualified personnel, is costly, and requires greater dedication time so it is a scarce format in web publications. In cases where audiovisual resources of greater difficulty predominate, they are usually accompanied by partnerships with institutions that support the dissemination of science, support the ideology of the profile, and promote some publications to highlight important scientific awareness events, as in the profile of @quantumfracture: "En colaboración con

@seo_birdlife y @ecoembes, te decimos el por qué: #NoAbandonesTusGuantesYMascarillas #ProyectoLIBERA (In collaboration with @seo_birdlife and @ecoembes, we tell you why: #Don'tAbandonYourGlovesAndMask #ProjectLIBERA)".

The use of music during the publication is a resource practically present in all cases, usually popular songs in social networks, which aim to evoke emotions and arouse feelings as they are highly valued resources for the achievement of media success and characteristic of media enunciation rules (Hjarvard, 2008). Regarding the presence of the voice in videos, influencers' profiles choose to be in front of the camera and work their own brand image through a direct allusion to the audience. In the cases of voice-over, they are usually expository pieces that explain processes while in the video there are curious and visually attractive situations.

As far as montage is concerned, the narrative category in the form of a chronological story is the predominant style and a sure bet for the audiences' understanding due to its logic similar to the narrative of everyday life. Sometimes, abstract montage appears, using misplaced images with different styles of music with no apparent sense, resulting in a risky discourse that is sometimes rejected by audiences for not understanding the meaning or the scientific reference. However, the creative montage is placed in an intermediate position that takes risks with unusual elements and speeds and tends to a better reception from the audiences.

Finally, it is worth mentioning the use of infographics as an indispensable element of the videos present on social networks. On the one hand, labels appear in almost 100% of scientific materials, either for lack of a narrator or by posing questions. This resource serves to provide the discourse with complementary information and highlight those data that should be of greater relevance to the audience. On the other hand, visual effects with striking sound effects are the other great infographic resource that makes the story attractive and reinforces the most amazing or inexplicable discourses.

As a result, music, montage, infographics, visual and sound effects, and resources originating from mass media that mediatize the logic of science dissemination (Hjarvard, 2018), are strategically used in the process of recontextualization of the experts' discourse to reach younger audiences (León et al., 2010) stimulating a more qualified common sense (Villela and Almeida, 2013).

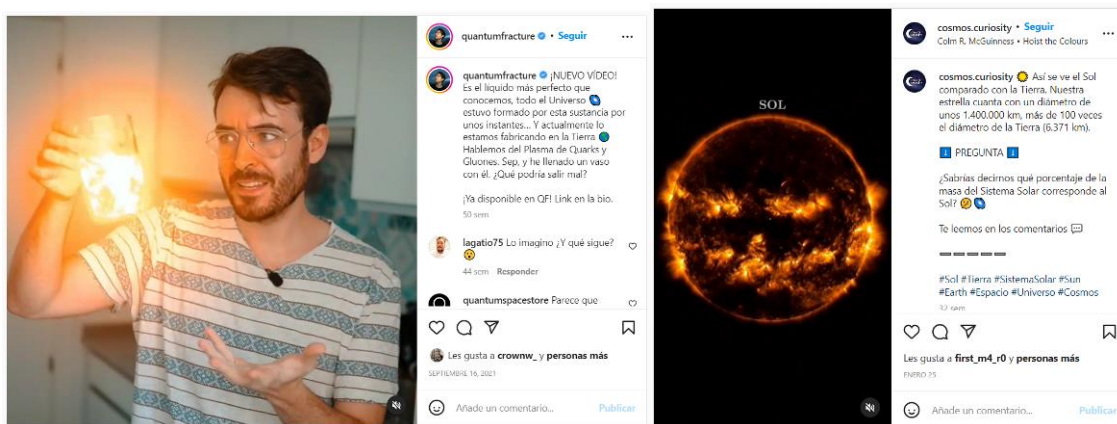
3.2. Storytelling characteristics

In this section, it is relevant to understand the predominant narratological characteristics in scientific videos. With the following objective, this section aims to know the position of the narrator, whether it is homodiegetic as protagonist or witness, or otherwise heterodiegetic, i.e. omniscient or objective. From what point of view the story is told and the mode of representation, whether it is expository with the explanation of processes, observational through visual illustration, interactive in the case that audience participation is required, or reflective if a debate or discussion on the narration of the topic is sought.

In the first instance, it is worth mentioning that Instagram as a social network does

not allow placing a description without a post, contrary to the functionalities of other networks such as Twitter, and they understand the post as the main part of the interaction. In our analysis, the main part of the publication is composed of the video and the description in textual format works as additional information. However, we can observe how on many occasions the description is used to provide essential information for the understanding of the video. And at other times, the description behaves as a place to pour information to lighten and simplify the material of the publication. The latter is the model of some of the cases in which most of the narration is detailed in the description of the publications and the audiovisual piece, the object of analysis of this article, functions as illustrative support (Figure 1). In short, the narratological issue is situated as a creative balance between the two spaces that must behave in a conciliatory way to achieve communicative triumph. However, the audiovisual structure remains an essential element to ensure a higher degree of retention of information (Arceneaux and Dinu, 2018).

Figure 1 Example of the presentation of information in a publication



Source: Own elaboration based on Instagram data.

Based on the analysis of the sample, it can be deduced that the position of the narrator depends on the nature of the profile. It has been found that influencer or institutional accounts that cultivate a closer relationship with audiences use a homodiegetic narrator from the position of protagonists or witnesses of the scientific subjects narrated. Thus, they appeal to the viewer, in the first person, from their own experience and narrate their experiences relating them to moments of everyday life to generate bonds of proximity. On the contrary, in publications in which the narrator is heterodiegetic, the profiles aim to demonstrate omniscient or objective knowledge, as if it were science itself addressing audiences in the third person from a privileged position concerning knowledge of the subject matter.

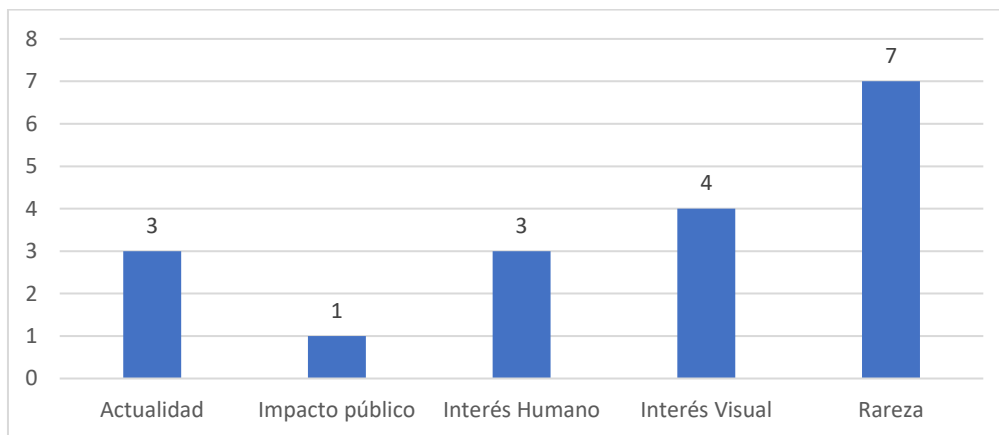
Finally, it is worth mentioning that the predominant mode of representation of history seems to depend on the nature of the profile. It has been possible to contemplate how influencers endow their publications with videos that provoke a reflective effect on the viewer to generate debate and discussion and thus provoke audience interaction through comments. Other profiles, such as groups of scientists and institutional accounts, focus more on the observation and exhibition of scientific advances, findings, or curiosities to inform through real demonstration and awaken a more formal interest.

3.3. Narrative techniques

Regarding narrative techniques, it is relevant to work on the explicit factors of interest that users may have when consuming scientific content. To this end, the parameters chosen in the methodology range from topicality, conflict, public impact, human interest, proximity, rarity, and visual interest. Likewise, the level of simplification (Muñoz and Jiménez, 2021) in the way of translating the scientific discourse and the method in the explanation of the concepts coming from science are also taken into consideration. The latter category assesses whether scientific terms are defined or explained or whether an interrelation between several scientific concepts is presented to facilitate their understanding.

The results obtained in the explicit factors of interest (Figure 2) indicate that scientific publications that demonstrate rarity as the objective of their discourse accumulate greater appeal among audiences: "Why is it recommended not to wear gold when handling mercury? It literally eats it!" (@aschemist). Curiosities and unpublished findings arouse reactions among audiences on social networks and also constitute a recurring resource in the media: "The secret of "The Countess of Chinchón", by Goya" (@museoprado). The visual interest of the publication is placed as the second explicit factor of interest. This is where the skills of the disseminator come into play in the design and audiovisual construction of the publication, recording or rescuing attractive images that surprisingly illustrate the content while maintaining scientific rigor (León et al., 2010).

Figure 2 *Explicit factors of audience interest in scientific content.*



Source: Own elaboration.

Current events and human interest are placed as factors of interest that function as a "reading contract" (Veron, 1997) based on the proximity of the subject to the publication. It should also be noted that the impact of this narrative technique will depend on the academic level and concerns of each viewer. Just as for a biologist, publications on the origin of microorganisms may arouse great interest due to their proximity, but the same content will suggest less relevance for the general public.

The level of narrative simplification (Muñoz and Jiménez, 2021) is considered medium in 61% of the publications. These results indicate that communicators prefer not to risk high simplification, so that understanding is complex ("● The Sun is a Yellow

Dwarf but in about 5000 million years it will become a Red Giant", @cosmos.curiosity), or low at the risk of making the content particularly simple or childish ("We pee inside before we pee outside 🚽🚽" @diariodeunacientifica). Likewise, the sampled profiles contain data and formulas that show that they target educated audiences who accept technical terms and complex information: "Can you tell us what percentage of the mass of the Solar System corresponds to the Sun? 🤔📊 We read you in the comments 💬" (@cosmos.curiosity).

Finally, it is worth noting how the narrative technique with greater relevance in the presentation of the discourse is through the explanation of scientific concepts or, to a lesser extent, through an interrelation between science concepts. However, explicit definitions of scientific phenomena or processes appear in only two cases of the object of study. In short, we deduce from these data that the concept of scientific definition is presented as a resource that is not very accessible or linked to academic study, which the receiver must decode individually. However, an explanation or interrelation of concepts leads to an easier expansion of knowledge directed by the sender of the message.

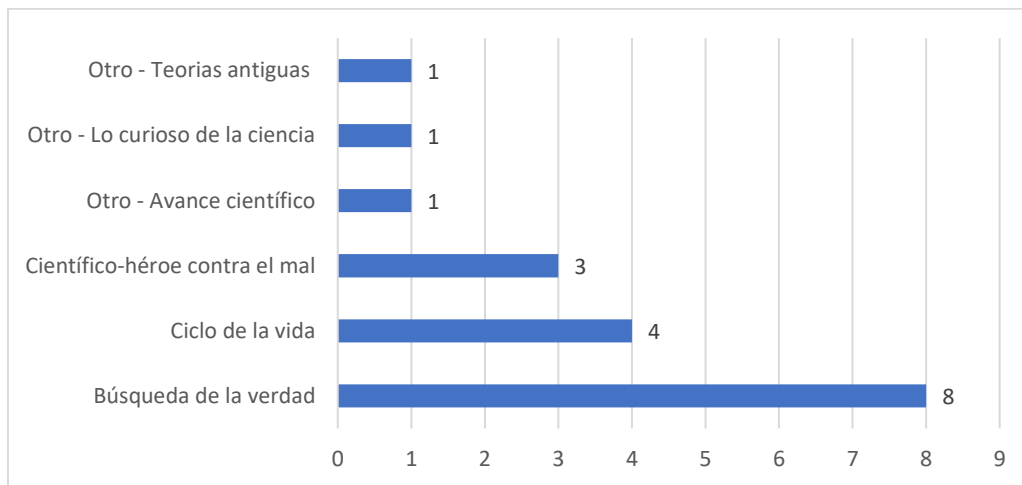
3.4. Dramatic techniques

In this section, it is essential to determine the type of story and its objective. First, to know what is the main dramatic intention that science communicators reflect in their audiovisual productions, whether it is the search for truth, the narration of a scientific mission or an expedition, whether it is related to the cycle of life, or whether the scientist acts as a hero against evil. Secondly, describe the existence and type of conflict, whether it is an individual against society, an individual against another individual, or, on the other hand, a group against another group. Finally, to clarify whether the production of scientific publications seeks to generate suspense as a narrative element for audiovisual consumption.

Regarding the objective of the story, during the process of analysis, it has been perceived that it is very difficult to integrate the narratives of social networks within the categories of scientific dissemination coming from scientific documentary methodologies. The reason is given by the length of the discourses. Among others, a documentary of 30 to 50 minutes has more space to develop the turning points of a script, the creation of conflicts, points of climax, and thus the harvesting of suspense in the story. However, scientific publication on Instagram has a maximum of 30 seconds in which it must formulate a narrative and often does not generate a complete cycle of presentation, plot, and ending. However, it takes advantage of brevity to shorten the content and vary its objectives such as the presentation of anecdotes or punctual scientific advances.

That said, as shown in the results (Figure 3), the main objective of scientific discourse lies in the search for truth, in other words, what is most attractive about science is that it answers questions that audiences already have or are provoked. On the other hand, the purpose of unraveling questions about the life cycle is a recurring theme since it is interesting for the public to know what our surroundings will be like as the years go by.

Figure 3 *Types of objectives in scientific publications.*



Source: Own elaboration

Finally, it should be mentioned that in the influencers' profiles, the position of the expert or disseminator as the scientist-hero against evil has been highlighted, which highlights the perception of researchers to audiences as professionals necessary for the global development of our society.

Regarding the creation of conflict, scientific publications are not characterized by the use of confrontation in their stories. Only in 4 of the 18 publications were resources perceived to turn a possibly controversial topic before another but at a very low level. Therefore, it should be noted that, regularly, the stories that manage to create suspense are those that manage to create conflict. However, the time available in the analyzed publications, always less than a minute, is not intended to generate expectations before the development of the plot but rather to convey the message coming from science and to define it as true and relevant content.

It is likely that dramatic intentions or the creation of conflicts implicitly carry a dose of sensationalism, as happens when extraordinary or strange features appear in the strategies to disseminate scientific discourse (León, 2001).

3.5. Rhetorical techniques

In the analysis of rhetorical techniques, it is taken into consideration whether scientific publications aim to create a community of interest and the type of argumentation that the discourse uses to demonstrate the story told, such as presenting examples, the authority of the narrator, the verisimilitude of the images, or the presentation of statistical data. All these narrative-rhetorical tools (León et al., 2010) aim to strengthen a more efficient construction of audiovisual discourse.

First of all, it should be noted that one of the main objectives of social network content creation sources is the creation of a community of interests in different social spheres (Francescutti, 2014). In other words, to create a group of people with common interests or passions, so that they entertainingly exchange ideas and thoughts through interactions, reactions, and comments following their audiovisual consumption habits (Francisco-Lens and Rodríguez-Vázquez, 2020). In 66% of the cases analyzed, the

intention of creating a community of interests is present through the formulation of direct questions to the public in the description of the publications. Examples include questions such as: Isn't it fascinating (@diariodeunacientifica), What could go wrong? (@quantumfracture), Did you know the fate of the Sun? 🌞 We read you in the comments 💬 (@cosmos.curiosity).

Concerning which rhetorical techniques are most effective, we find that the use of examples is presented in 61% of the total cases. So, providing a visually interesting treatment (León et al., 2010) of particular cases to illustrate what is being narrated helps audiences understand scientific phenomena or processes. Finally, it is worth mentioning that resources such as authority or statistics are the least used by scientific publications, probably because they are techniques that require more time for explanation, which is precisely what social networks lack.

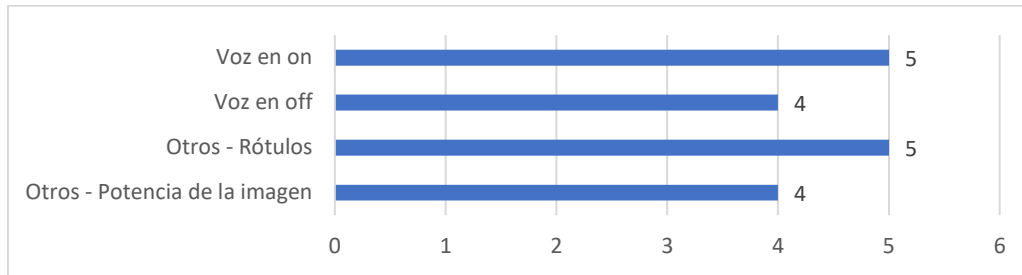
3.6. Mediation process

The last aspect that makes up the content analysis of scientific publications is the mediation process, i.e., in an economy of attention (Zulli, 2017) how the communicative activity between the sender and the audience is resolved and what attitudes the content creators acquire. At this point, it will be taken into consideration how the roles of scientists or disseminators are represented and to what extent, whether they act as experts, detectives, guides, or other figures. Likewise, the type of mediation will be part of the analysis, whether the facts are narrated with a voice on, voice off, through an interview or a group discussion, and, finally, to inquire through what elements it is possible to generate greater entertainment for the audiences. To do this, the elements used must be identified, whether it is through the presence of personalities, powerful images, the weight of the story, anecdotes, or other different elements. Always, with the premise of whether these elements contribute to the audience's understanding of the relevance and interest of a scientific event (Polinario, 2016).

The mediation process that has been most predominantly observed in the significant cases is the profile of the expert who demonstrates to have a lot of knowledge about the scientific subject or who has a great experience in that work or activity. Mediation through the figure of the detective occurs in cases of communicators who are not experts in the subject and we can identify it through phrases such as: "I had to research to believe that this is real, but yes, urine is pumped like this 😬" (@diariodeunacientifica).

However, it could be observed (Figure 4) that mediation does not have a clear formula but chooses different elements depending on the profile's posting style. For example, influencer accounts that choose to speak directly to the camera, rarely modify the style of their posts and keep it that way to build loyalty with their audiences. Others, such as two of the institutional accounts, choose to post taglines and take advantage of the visual power of images without including narrators that appeal directly to the audience.

Figure 4. *Type of mediation in scientific publications.*



Source: Own elaboration.

Finally, the two main elements that help in the generation of entertainment in the discourse have been identified. As can be seen in Figure 5, the level of entertainment depends mainly on curiosity about the topic and the images presented in the publication.

Figure 5. *Factors of entertainment generation in the mediation process.*



Source: Own elaboration.

The visual impact of the images present in scientific publications implies a commitment to truth and a representation of what is real that does not require the presence of other more costly elements such as the presence of personalities or the construction of a great story. Images become an infallible ally for science (Arceneaux and Dinu, 2018), in a sense of demonstrating, exemplifying, and appealing shortly and quickly to audiences on social networks.

3.7. Communicative dimensions of the profile

It is noteworthy that each content creator adapts the communication strategy according to the resources and privileges it has as a profile. In other words, @nasa_es, as an institutional account, has as a differentiating element the visual power of its publications because it has unpublished images of space from its own experiments or scientific missions. On the contrary, an influencer such as @diariodeunacientifica with scarce resources, which could hardly obtain NASA's images, focuses its strategy on the creative and attractive presentation of external resources from other scientists. However, both strategies possess the capacity to promote informal education and scientific literacy beyond serving as an image and showcase for scientific institutions (Brown et al., 2019).

Another aspect to take into account is the shtick or personality of the profile (Zulli, 2017) as an element of loyalty to the account and its audience. In this regard, it is worth mentioning the positive impact of the figure of the influencer as a personal brand

to disseminate science content. These accounts build a persona and characterize the type of dialogue so that interaction flows easily among their community. Likewise, their collaboration with funding companies (as is the case of @quantumfracture with @ecoembes) promotes the use of the platform to promote social and political activism akin to the brand and the ideology of the audience (Zulli, 2017). However, the influencer strategy can be risky for other profiles, as is the case of institutional accounts, since the centralization in a figure can be unstable for the brand if it disappears and in which its political positioning tends to neutrality. In the case of the Prado Museum, as it is a historical organization, its communication strategy focuses on making its contents more attractive, telling anecdotes and curious facts but the presentation of publications has a more classic and conventional look.

Finally, it is worth mentioning that the profiles of scientific groups are the ones that have the least defined format. These accounts present diverse narratives, sometimes more journalistic in a reportage format, or sometimes grouping different independent influencers who collaborate with the channel. They also allow for more abstract artistic creations and have greater difficulty in building a personality around the account.

4. CONCLUSIONS

In the process of dissemination, the scientific message undergoes a recontextualization (León et al., 2010) of its content to adopt the grammatical and discursive rules of media language (Hjarvard, 2008). During this transition (Villela and Almeida, 2013) it is essential to maintain the discursive balance between scientific rigor (León et al., 2010) exposed by experts and clear and quick readability by audiences (Muñoz and Jiménez, 2021). In this process, the audiovisual format has in its communicative syntax a character that allows innovation, invention, and aesthetic experimentation (Dávila, 2017). This aesthetic plasticity is a strong ally for scientific dissemination when associated with communicative functionalities and interaction with users such as those offered by Instagram (Polinario, 2016). A social network in which the use of the still or moving image through short and brief messages is constituted as the center or main support of the narrative (Arceneaux and Dinu, 2018).

To clarify which are the elements of the audiovisual discourse of greater media impact found in the Instagram social network, the following conclusions are presented:

- At a formal level, videos strive to generate the greatest possible closeness with audiences by using their own images *ex professo* for publications and incorporating music, sound effects, and infographics that generate emotional and attractive scientific content.
- The position of the narrator in audiovisual publications will depend on the nature of the scientific profile. Institutional accounts will maintain a greater distance from audiences than influencer profiles that appeal directly to their community of followers.
- At the narrative level, weirdness becomes the great ally of science as an explicit factor of interest and establishes itself as a common resource in both scientific and media discourse.

- The search for truth is presented as the dramatic intention most used by science popularizers, although the figure of the expert-disseminator as the scientist-hero against evil is gaining more and more strength among audiences.
- Publications strive to generate a community of interest to entertainingly exchange ideas and thoughts through rhetorical techniques such as the use of examples of scientific phenomena and the posing of questions to followers.
- Finally, the figures of expert or detective are the roles chosen by scientists or disseminators for mediation with their audience and it is determined that the advisable factor for the generation of entertainment in scientific publications on Instagram lies in the power of their images.

Consequently, each profile constructs a ritual and organizes the syntax of its method to effectively present scientific topics to its followers and to build the loyalty of its audiences in a specific reading contract (Veron, 1997). Science communicators, from their profile, transform scientific knowledge to adapt it to the practical interest of their audience and endow it with fascinating and moving aspects to link it to the everyday life of their audience. The results of the analysis determine that the adaptation of content to the characteristics of each audience is the most convenient way to increase interest in science; on the contrary, it will be difficult to highlight these contents in the current context of information overstimulation.

Finally, it is noteworthy to highlight that the present study has been carried out singularly with a limited number of Instagram accounts that have allowed significant deductions at the audiovisual level. However, the purpose of the research is to continue with the analysis of large-scale scientific publications using computational intelligence and to contrast the different results by confronting small and big data studies.

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