Web 2.0 and informational treatment in the main Spanish magazines of scientific and pseudoscientific contents

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Abstract
Introduction. The research analyzes 6 scientific and pseudoscientific magazines in terms of web 2.0 tool usage and informational treatment. **Methodology.** The digital ecosystem of the magazines is explored and described, and subsequently a quantitative and qualitative content analysis of 232 units is elaborated. This sample is probabilistic and selected randomly from a universe of 1,434 publications of the magazine's web, Facebook, Twitter, YouTube and Instagram accounts. **Results and conclusions.** The results show that use of 2.0 resources is basic and features of social networks are hardly exploited. In addition, although many images are used, news are not accompanied by videos, info-graphics or other types of interactive resources. The information treatment presents a need of improvement, more news should be accompanied by their authorship and the source of images more often captioned.

Keywords
Scientific journalism, pseudoscience, printed press, web 2.0, cyberjournalism, scientific divulgation.

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Translation of abstract by **M. Portalés-Oliva**
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1. Introduction

The consolidation of Internet and its great communicative potential promoted that media quickly created their digital editions. This phenomenon produced both in printed newspapers as well as specialized journals. In Spain, the incursion of online or digital newspapers occurred in the start of the nineties (Bella-Palomo: 2004). Afterwards, web 2.0 introduced a series of changes destined to potentiate horizontality, collaboration and participation of Internet users in communicative processes (O'Reilly: 2005). The collective intelligence (Lévy, 2007) and participative culture (Jenkins, 2008) are only some of the defining features of these transformations that have influenced both the mediatic system and the society as a whole (Piscitelli, 2002). The fast growth and penetration of social networks have turned them into platforms with a great leading role in the communicative ecosystem of all media (Castells: 2003): televisions, radios, newspapers and specialized journals. The concept of 'media ecology' (Scolari, 2013), understood as the constitution of scenarios directly impacted by communicative technology changes (Barabási and Bonabeau, 2003), have extended in the current mediatic landscape presided by 'transmedia' nature contents (Rodríguez-Ferrándiz and Peñamarín: 2014). Media need to adapt to this new setting through the articulation of communicative ecosystems that allow them to integrate more than one platform to diversify their channels and, specially, to amplify their messages' reach. This milestone produces within economic, political, cultural and educational contexts that have acquired a "liquid" essence (Bauman, 2002). Users consolidate as generators of contents and stories that comprise all current topics (Guerrero-Pico and Scolari: 2016).

Scientific information and scientific diffusion are two different functions (Belenguer: 2003) that media can contribute to fusion through the theoretical frameworks of specialized journalism. Media focused on the dissemination of science must equally respond to these transformations that the Web 2.0 introduces and that impact contents' design, production and distribution. This aspect is affected by the growth of interest in science that has produced in an exponential manner during the last years, shifting from 6.9% in 2004 to 16% in 2016 (Fecyt, 2017a: 4). In this sense, an adequate selection and use of 2.0 resources is decisive for journals specialized in scientific themes. For instance, studies confirm that the inclusion of info-graphics in articles help understand concepts with less difficulty, as Bucchi and Saracino say (2016). In this sense, the audiovisual also gains relevance, as CISCO mentions (2016), audiovisual consumption of information will be mainly visual in 2020. In that same line, the *VNI Forecast* detected that in the next years, 82% of the total Internet traffic will be in video format and this consumption will be done mostly through a mobile device (Ericsson, 2015). The results of these studies indicate transformations that impact the transmission, distribution and access to contents; and which entail digital challenges to media in general (Rodríguez-Ferrándiz; Ortiz-Gordo and Saéz-Nuñez: 2014).

Citizens use dialogic platforms more and more in their access to the latest news both generalist and specialized. According to the *VIII Survey on Social Perception of Science* made by Fecyt (2017), Internet is the most used media to get informed about science and technology in the age range between 15 and 34 years old, with a mean of 80% of population. Between 35 and until older than 65 years old, television gets a greater consumption (with a 71%), followed by printed press among older than 45 years old (with 32% in average). Those who interest more about science and technology are mainly young people between 15 and 24 years old. This interest reduces as age increases.

Among the individuals that use Internet to get informed, most used platforms to access this information are social networks (75.4%) and audiovisual contents (62.3%) (Fecyt, 2017b).

Figure 1. Interest for science and technology by age
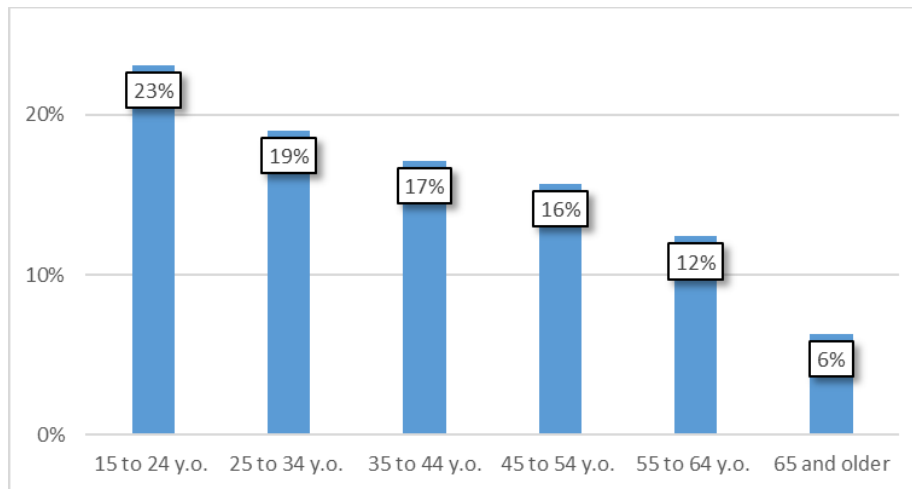
Source: Authors' own creation based on Fecyt (2017b: 11)

According to Spain's Digital News Report, "the younger individuals trust networks more (41%) than traditional informative organizations (36%) when it comes to differentiate facts from unfounded rumor. A study states that the youngest individuals do not know how to differentiate between publications and announcements in the information they consume on Facebook (Standford History Education Group, 2016).

Figure 2. Access to media to look for information about science and technology by age and gender

	TOTAL	SEXO		EDAD					
		Hombre	Mujer	De 15 a 24 años	De 25 a 34 años	De 35 a 44 años	De 45 a 54 años	De 55 a 64 años	De 65 y más años
Internet (prensa digital redes sociales y otras web)	57,8%	58,9%	56,8%	82,1%	77,5%	67,1%	56,4%	39,0%	12,2%
Libros	12,0%	11,5%	12,5%	19,6%	11,2%	11,0%	12,3%	10,1%	7,6%
Prensa escrita en papel	27,9%	32,1%	24,2%	18,0%	24,6%	29,5%	34,0%	33,4%	29,9%
Radio	27,1%	28,6%	25,7%	19,8%	20,7%	26,9%	30,8%	30,9%	36,5%
Revistas de divulgacion científica o técnica	7,6%	7,9%	7,3%	7,4%	10,1%	8,5%	9,2%	7,0%	2,1%
Revistas semanales de información general	7,4%	6,3%	8,3%	7,8%	6,4%	6,7%	8,7%	8,0%	7,0%
Televisión	71,2%	70,6%	71,7%	73,3%	69,7%	70,5%	72,4%	70,1%	71,2%
No me informo	0,1%	0,0%	0,1%	0,1%	0,0%	---	---	0,0%	0,2%
Otras	1,6%	1,5%	1,7%	2,5%	1,5%	1,2%	2,2%	1,4%	1,2%
Ninguno	10,5%	9,3%	11,5%	7,6%	7,9%	9,0%	7,6%	12,9%	19,6%
No sabe	0,5%	0,4%	0,6%	0,3%	0,6%	0,5%	0,6%	0,3%	0,8%

Porcentajes más destacados en sentido horizontal
Porcentajes menos destacados en sentido horizontal

Base: Total de personas entrevistadas (n=6.357)

Source: Fecyt (2017b: 248)

On the contrary, 46% of older than 65 years old believe that informative media help discriminate between facts and fiction against a 22% that considers that role is performed by social networks" (Vara-Miguel, Negredo and Amoedo, 2017: 5).

In the ranking of most used platforms to have access to information about science on Internet in third place, there are digital media and in the place before last, the specialized digital media (the object of study of this research), according to Fecyt (2017b). Scientific or technical journals get very little protagonism and there are no huge differences between consumption ages. An average of 7% maintains (Fecyt, 2017b: 248).

The interest towards them has reduced 6% compared to 2014. Its access is 33.6%, almost 10 points below access to this information through instant messaging in platforms such as WhatsApp, which obtains 42% (Fecty, 2017b: 271). Based on Spain's Digital News Report (2017), "now, there are as many news shared through instant messaging than through social networks" (Vara-Miguel, Negredo and Amoedo, 2017: 10).

Figure 3. Information through the Internet and the following media
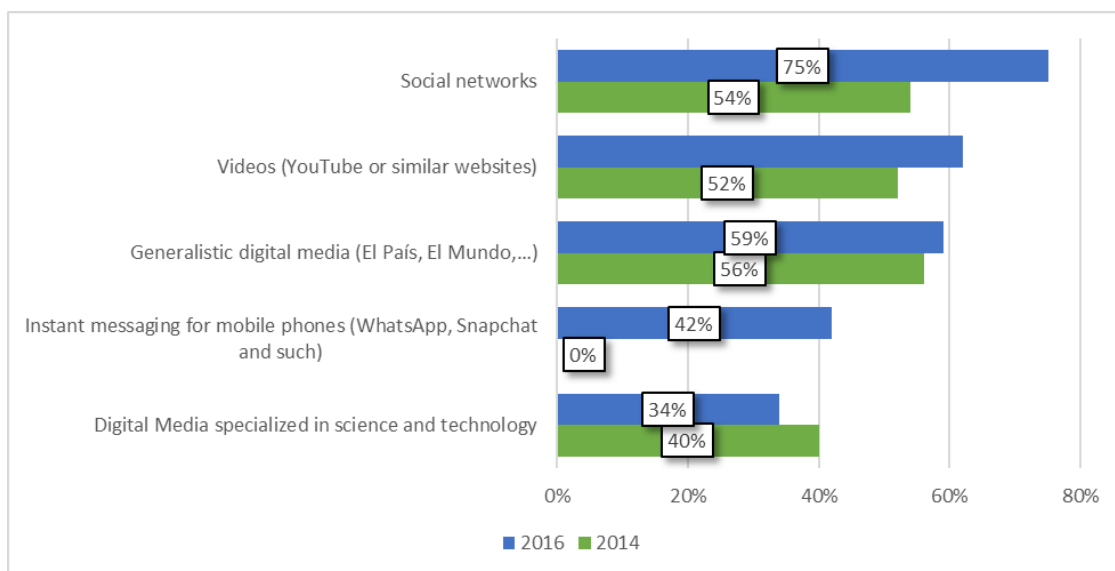
Source: Authors' own creation based on Fecyt (2017b: 271)

The most significant statistical increase between 2014 and 2016 is linked to access to science and technology information through social networks, as well as videos. On the other hand, the most important decrease is that of media specialized in science and technology. Besides, those individuals using social networks to get informed about science, do this mainly through "Facebook (93.8%) and secondarily through Twitter (37.3%), a media that has moved back in favor of Instagram compared to 2014" (Fecyt, 2017b: 273). In this sense, regarding the general consumption of information, Spain's Digital News Report (2017) states that during the last year, the informative use of WhatsApp (from 26 to 32%) and YouTube (from 19% to 26%) has increased. Facebook consolidated in (47%) and Twitter (with a 18%) decreased (Vara-Miguel, Negredo and Amoedo, 2017: 73).

After analyzing Fecyt's data (2017), the main question of this study is, therefore, whether digital editions of specialized publications have made the most of Web 2.0 resources and whether they exploit them with communicative solvency.

Web 2.0 offers these magazines a wide range of resources, tools and platforms of great informative, communicative and diffusion value. Its correct selection and application is decisive in the generation

of quality contents. The rigor and accuracy of the use of information sources also joins therein. The dissemination of science through digital headings introduces a series of questions about what informative attributes of Internet are applied most and how are they used to generate and disseminate contents of different approaches and typologies. In this context, the present study analyses digital editions of the main magazines that the Office of Justification on Diffusion (OJD) classify under the category of "Scientific and pseudoscience". These are 6 publications that can be purchased in printed edition and published monthly. The analysis starts from its website to include afterwards, the ecosystem of platforms linked thereto with informational functions.

Table 1. Analyzed magazines

Magazine's Title	Publications' average	Diffusion/ distribution average	Diffusion/ distribution percentage
MUY INTERESANTE	195.927	122.541	63%
NATIONAL GEOGRAPHIC	145.172	111.689	77%
QUO	85.213	41.507	49%
INVESTIGACIÓN Y CIENCIA	21.386	12.059	56%
AÑO CERO	38.737	10.200	26%
ENIGMAS	19.322	5.606	29%

Source: Authors' own creation based on OJD data (2016)

Considering the aforesaid, the paper has been structured around three research questions:

- What tools and informative resources typical from Web2.0 do printed magazines use on their digital platforms?
- What typology of information sources predominate on the online contents of the main science and pseudoscience magazines of Spain?
- What informative attributes have greater presence on messages these publications disseminate?

2. Theoretical background

Scientific dissemination demands professionals skilled with a series of competencies and specific abilities (Calvo-Hernando, 2002). As Belenguer-Jané indicate (2002), media and specially, magazines specialized in the diffusion of science must be able to generate quality and appealing contents for the public beyond the negative images that have been associated to these themes (sudden, boring, complex, alien to the reader's interest, etc.). To the publishers of these kinds of contents corresponds explaining complex processes and concepts of great relevance for the society. "The difficulties for making a rigorous, demanding and responsible journalism is evident, as well as obliged to compete, at present, […] with the pseudosciences disturbing for the individual and the society, but that make the most of the appealing nature of the mysterious, unknown and irrational" (Calvo-Hernando, 2002: 18). To the competition derived from the hatching of digital contents about pseudosciences, there joins the multiplication of issuers and media that potentiate the collaborative logic of Web2.0. Besides, cyberspace has introduced the possibility to generate messages of hypertextual nature, as well as multimedia, interactive, Mashup (Tejedor-Calvo, 2007) and, in the last years, transmedia (Scolari, 2012).

Different authors have studied the evolution of media (Piscitelli, 2002; Castells, 2003; Manovich, 2005; Mc Combs, 2010; Galindo, 2010; Martín-Barbero, 2015), the transformations of the business model (Flores and Aguado, 2005), changes in the production of informative attributes of their messages (Orihuela, 2006; Salaverría, 2006; Larrondo; 2008), the new educational demands (Tejedor, 2006), or the impact generated by technological changes (Abadal and Guallar, 2010), especially the ones derived from Web 2.0 (O'Reilly, 2005; Lévy, 2007; Igarza, 2008). These authors insist in the relevance of increasing collaborative routes (with different levels of interaction) and coincide in highlighting the weight that, progressively, social networks have been acquiring in the mediatic landscape.

The social media have potentiated access of users to specific contents and furthermore, have widened interaction possibilities (Boyd, 2007). This way, the access to more specific and specialized contents has turned into a consolidating trend (Pisani, 2006). In addition, the establishment of relationships with other users and the constitution of a digital identity are some of the main motivations that drive Internet users to use these platforms (Cheung *et al.*, 2011; Colás *et al.*, 2013; Flores, 2009). Turned into prosumers (Toffler, 1980), the new users highly value the possibility of producing, exchanging and promoting all kinds of contents (Chung *et al.*, 2016) and of defining a profile in their digital ecosystems that represents their own interests and concerns (Gentile *et al.*, 2012).

The heterogeneity that defines the current public of cybermedia demands a series of strategies to get to the profiles of users that consume digital contents. In the academic field, studies indicate that young individuals value Internet as a channel suitable to suggest questions and receive answers about their concerns about science and its progresses, as show on Fecyt's data (2017). Moreover, these researchers add that university students inform about scientific themes through digital editions of media since the incursion of social networks (Macedo-Rouet *et al.*: 2003). This aspect directly impacts specialized magazines in the scientific dissemination because its recipients are quite uneven regarding the kind of interests and their habits of online information access. The younger Internet users prefer social networks and audiovisual platforms like *YouTube;* while those of older age value the possibility of having access to more specific contents and linked with their thematic interests (Nuñez-Gómez et al: 2012). Therefore, specialized magazines must be able to exploit the communicative capacities of cyberspace, on one hand; and of generating contrasted and quality specialized contents, on the other.

Olvera-Lobo *et al* (2014) warn about the fact that the scientific institutions do not make the most of the communicative potentialities of web 2.0 and do not show any interest for using their resources and platforms to raise interest for these topics among the younger public and the society as a whole. In this scenario, magazines specialized in science must adapt to a series of transformations that impact the type of contents they generate and digital platforms used to promote them. These comparative study between scientific magazines and others positioned in the field of pseudoscience allow elaborating a diagnosis approach towards the characteristics of digital ecosystems generated in one case and the other, and besides the type of messages and information sources that predominate in each one of them.

Regarding previous studies of the studied sample, the author Vicente-Domínguez (2012) elaborated a qualitative study of the presence of the magazines *Muy Interesante*, *National Geographic* and *Quo* on social networks. The research concluded, through in-depth interviews to their responsibles, that the presence on these online platforms is mainly "to increase access points to their contents and to approach more towards users" (p.944). In this same line, Bolufer-Colomar (2016) studied the transformation of printed news into the online versions of *Muy Interesante*, *Quo* and *Materia* for three months in 2016 through a quantitative contents analysis and through in-depth interviews with the

directors. The study concludes that magazines do not know how the make the most of tools offered by Internet. Additionally, regarding the differences between printed and digital versions, in *Muy Interesante* only 0.42% repeats the same content, but "in *Quo* there is a total of 19 pieces of the online version that also appear in the printed format, reaching 3.52% of the total. From these 19 publications, 13 keep the same content (68.42%) and 6 have a more extended content (31.58%)" (Bolufer-Colomar, 2016: 28). In comparison, Ana Bellón (2016), in a similar study, concluded that *Tercer Milenio* and *Quo* have known to adapt to the network without reducing their paper audience. The researcher, using a content analysis and a series of in-depth interviews, determined that "guarantee the society a permanent volume of scientific information [and] as time goes by, they have adapted to the new technological possibilities and demands of their publics to offer that information both in printed version as well as in the network" (Bellón, 2016: 455). Regarding the magazine *Año Cero,* Vegas-Vega (2015) interviews the director of the publication, who highlights that the magazine's theme oscillated between basic popular science and "occultism and the boundaries of knowledge", because they needed a specialization in contents offered, since *Muy Interesante* already occupied the other territory. In this sense, social networks are conceived as platforms to capture audience and Internet is its main information source. "Internet entailed a revolution in all senses. In our field, it helped to a great extent, because before it was very complicated to gather rigorous information related to mystery due to its difficult welcoming in the serious journalism" (Vegas-Vega, 2015: 56).

3. Methods

We have examined the digital ecosystem of the 6 magazines classified as "Scientific and pseudoscience" based on OJD data still active on 2017. The seventh magazine identified under this category was eliminated from the sample (Geo of G+J editorial), because it ended its online activity in 2016.

After exploring the online presence of these monthly publications (that are still published in printed version) we decided to perform a quantitative and qualitative contents analysis of their digital publications for a week on October 2017. We gathered a total of 1.434 analysis units corresponding to posts on Twitter, Facebook, YouTube, Instagram and on their website between October 4 and 11, coinciding with the announcement of the first Nobel Prizes on that year. In the fieldwork collecting week, the elevated number of publications of *Muy Interesante* outstands with a total of 897, quite above the average of remaining publications that week (which was 107). The other magazines had a lower number of analysis units. *Año Cero* and *Enigmas* summed 63 each; *Investigación y Ciencia* generated a total of 65; *National Geographic* produced 172; and *Quo* accumulated 174. In the case of *Muy* Interesante, which online content is not dated, we chose the most read news of the website as analysis units.

From this universe of 1.434 units, we selected a probabilistic random sample of 350 analysis units [1] which means 50 per magazine. However, during sample coding, this number reduced to 232 due to the repetition of some publications that reproduced exactly the same content or with textual formulations and graphic representations without hardly any variation. Therefore, almost identical results were generated. The final sample is considered representative because it has a confidence level above 90% and with an error margin of 5%.

The content analysis was designed from variables that responded to research questions. Therefore, they were divided into two axes: a) The digital ecosystem based on elements typical from web 2.0 and b) The informative treatment from a journalistic approach. The first variable axis aims to become an extension of existing researches about these magazines made by Vicente-Domínguez (2012), Vegas-

Vega (2015), Bellón (2016) and Bolufer-Colomar (2016). The last two axes of analysis are based on an adaptation of the template and code book of Cano-Orón *et al's* methodology (2017).

Table 2. Content analysis template

Analysis items	Variable	Categories
Identification	Number of analysis unit [2]	#
	Number of news	#
	Magazine it belongs to	1. *Año Cero 2. Enigmas 3. Investigación y Ciencia 4. Muy Interesante 5. National Geographic 6. Quo*
	Publication typology	1. Twitter 2. Web 3. Facebook 4. Instagram 5. YouTube
Digital ecosystem	Includes Emoji	0. No 1. Yes 2. Not applicable
	Includes Hashtag	0. No 1. Yes
	Includes Imagen	
	Includes Video	0. No 1. Yes, in analysis unit 2. Yes, in the link
	Statistics/ Graphic material	
	Includes Links	0. None 1. Own 2. External 3. Both
	Announces printed content	0. No 1. Yes, in analysis unit 2. Yes, in specific link 3. In both 4. Not applicable
Informative treatment	Theme	1.Space 2. Alien 3. Ghost/ Paranormal 4. Strange animals 5. Culture / Language 6. Medicine 7. Physics / Chemistry 8. Technology 9. Geography 10. Biology 11. Travels 12. History 13. Religion 14. Sociology 15. Mathematics 16. Others
	Informative function	1. Promotion 2. Spectacle 3. Science Diffusion 4. Standard/ neutral news
	Language	0. No text 1. Specific 2. Common
	Writing in first person	0. No 1. Yes 2. Not applicable
	Mention to journalist	0. Doesn't have author 1. Yes, in the analysis unit 2. Yes, in the news content 4. Entity / Press note 5. Not applicable
	Image/ text consistency	0. No 1. Yes 2. Not applicable
	Image source	0. Does not cite the source 1. External image 2. Own image 3. Not applicable
	Typology of image	1. Normal picture 2. Testimonial 3. Drawing/ Animation 4. Photomontage 5. Magazine' cover / Internal page 6. Not applicable 7. Belongs to databases

Source: Authors' own creation based on Cano-Orón *et al*. (2017)

4. Results
4.1 Digital ecosystem of magazines: presence and impact in the Network

The digital ecosystem of selected magazines shows a landscape marked by the relevance of Facebook and Twitter (see table 3), where all publications have a profile of their own. However, the number of followers and reach varies greatly between them. Compared to the rest of platforms, we detect relevant differences. On one hand, only two of the magazines (*Muy interesante* and *National Geographic*) have Instagram accounts, with 465.000 and 61.200 followers, respectively. On the other, the presence on YouTube is extended and, except for two magazines (*Año Cero* and *Investigación y Ciencia),* all of them are present in this platform.

Table 3. Presence on social networks.

Magazine's title	YouTube	Instagram	Facebook	Twitter
AÑO CERO	0	1	1	1
ENIGMAS	1	0	1	1
INVESTIGACIÓN Y CIENCIA	0	0	1	1
MUY INTERESANTE	1	1	1	1
NATIONAL GEOGRAPHIC	1	1	1	1
QUO	1	0	1	1

Source: Authors' own creation.

Figure 4. Presence on social networks of the universe
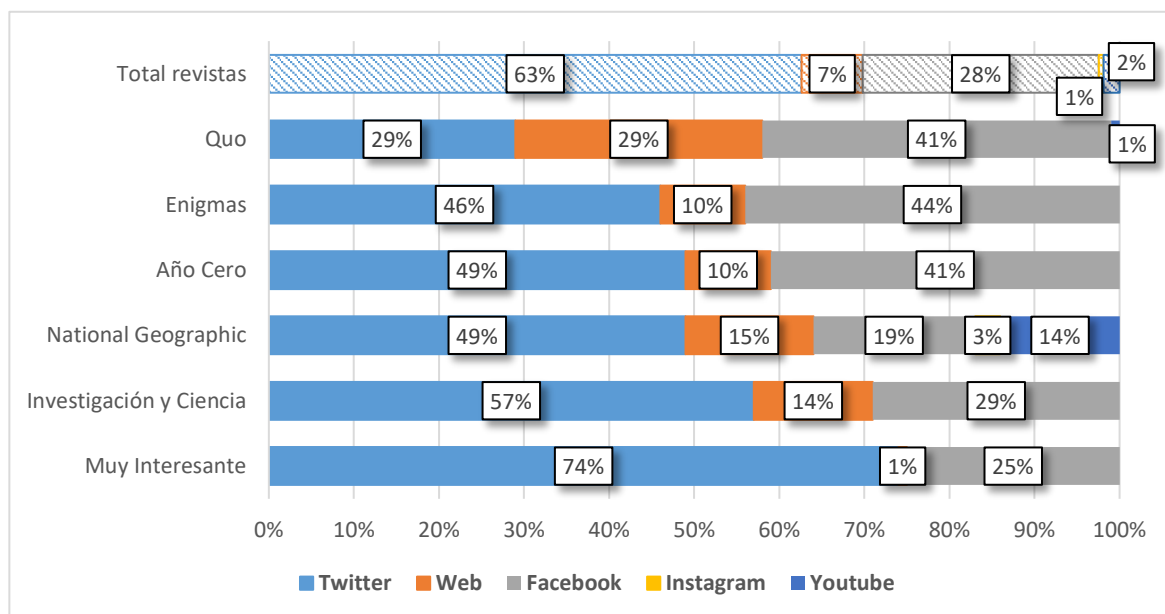
Source: Authors' own creation (2017). N=1434 publications between October 4-11, 2017.

The bet on these kinds of platforms responds to the usage trends that different studies have identified in the last years. Magazines prefer tools and social networks that have a greater penetration among their public. Platforms used most by Spanish individuals are WhatsApp (92.8%), Facebook (87%), Twitter (48.9%) and Instagram (40.4%), according to AIMC's data (2017). There is a correspondence between these general usage data and the acceptance of the different social networks and the digital ecosystem of each one of the magazines (see table 3). We observe that Facebook and Twitter are the platforms used the most, followed by YouTube. Finally, there is Instagram, only present in half of sample's magazines despite its relevant penetration (AIMC, 2017).

In the case of Twitter, relevant differences between publications analyzed are detected. The reach of publications accounts indicates (see table 4) that different publications (such as *Muy Interesante, Investigación y Ciencia* or *National Geographic)* have an actual reach inferior to the number of followers of their respective accounts. This aspect alerts about an inadequate management of said platforms and suggests the need of reformulating the communicative strategy on this network to widen the impact of their publications. On the other hand, magazines such as *Quo, Año Cero* or *Enigmas*

show more coherent numbers since the reach is superior to the number of individuals that follow their Twitter accounts.

Table 4. Presence and reach on Twitter (September 2017)

Magazine	Twitter Followers	Number of Tweets	Onset of Twitter activity	Reach
MUY INTERESANTE @muyinteresante	8.280.000	126.000	July 2008	7.188.013
INVESTIGACIÓN Y CIENCIA @IyC_es	379.000	13.700	December 2012	105.194
NATIONAL GEOGRAPHIC @RevistaNatGeo	284.316	15.239	January 2010	100.727
QUO @RevistaQuo	237.000	84.500	June 2009	327.298
AÑO CERO @revistaANOCERO	26.500	4.591	February 2012	79.096
ENIGMAS @revistaENIGMAS	19.600	5.102	February 2012	58.502

Source: Authors' own creation based on Twitter and Tweet reach data

Regarding 2.0 tools, contents analysis identified a low exploitation of resources of the social web in magazines overall. None of them potentiates the use of thematic or specific hashtags and neither promote the use of emojis that could be perfectly integrated on Twitter, Facebook, Instagram or YouTube. Specifically, 22% of analysis units have hashtags; while the inclusion of emojis is almost nonexistent with only 3% of presence in all publications.

One of the good practices observed and that is not very usual, is the following:

Figure 5. Examples of tweets

Source: Twitter account of *Investigación y Ciencia*

Source: Twitter account of *Enigmas*

The use of links to scientific institutions or individuals -through (@) mentions or links- is rather scarce on Facebook and Twitter. In the case of Twitter publications analyzed, only 1% use @. The analysis units are depersonalized, because the reader cannot access papers' official researchers' or authors' accounts from these social networks. This aspect also hurdles access to primary information sources,

both to centers or research projects as well as to the monitoring of authors' personal portfolio. Hence, since the authors or scientists are not named (either through @ or hyperlinks), online news loose actual or ideal reach they might achieve. Since they are not retweeted nor shared by stakeholders involved in the news, there is a loss of new audiences, which are mainly in the private accounts of scientists or journalists.

Regarding the inclusion of audiovisual pieces, there is a huge difference between images and videos that illustrate content. 90% of analysis units are illustrated. However, only 2 of the 220 publications have videos included in the post, excluding content published on YouTube. Besides, in those two cases it is a promoted content. A documentary about emotions elaborated by *Quo* together with the automobile company Mazda, where the act of driving is added as an emotion to be studied [3]. Only 7% of news have videos integrated inside the text; while the incorporation of info-graphics or statistic material is rather scarce, only 2% have these kinds of images inside the news contents.

**Figure 6. Audiovisual accompaniment**
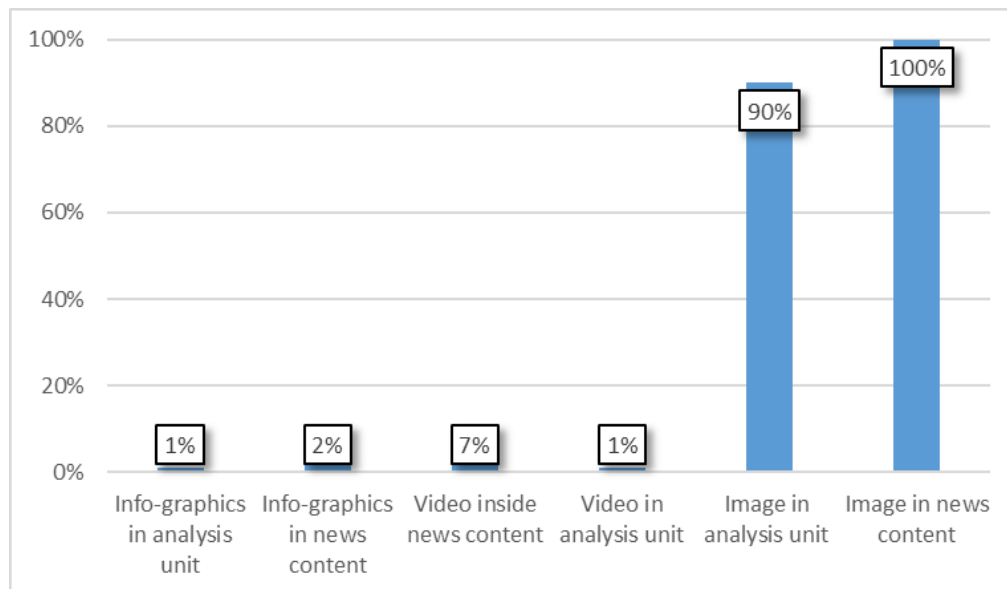
Source: Authors' own creation N=220 analysis units / N=192 news contents [4]

Regarding the use of links, most of magazines promote their own content. As a qualitative appreciation, it is worth mentioning that some of the external links aim to promote publications of the same editorial. For instance: *Muy Interesante* promotes *Muy Historia*; *Año Cero* refers to *Enigmas*, because both are part of the *Prisma Publicaciones* editorial; or *National Geografic* promotes *Viajes NatGeo*. Therefore, magazines are very reluctant to share external contents on their social networks, either from scientific studies as well as other media.

In the use of links in the news contents, we identify that magazines *Muy Interesante*, *Año Cero* and *Enigmas* elaborate hyperlinks of documentary type that connect with file contents or the magazine's historic archive. On the other hand, *National Geographic* incorporates links to external contents. *Investigación y Ciencia* uses external links and tends to position internal hyperlinks at the end of news to promote topics related to the publication. Finally, *Quo* characterizes for showing external links inside the news contents or article that do not include any kind of link.

Figure 7. Typology of links in analysis units by social network
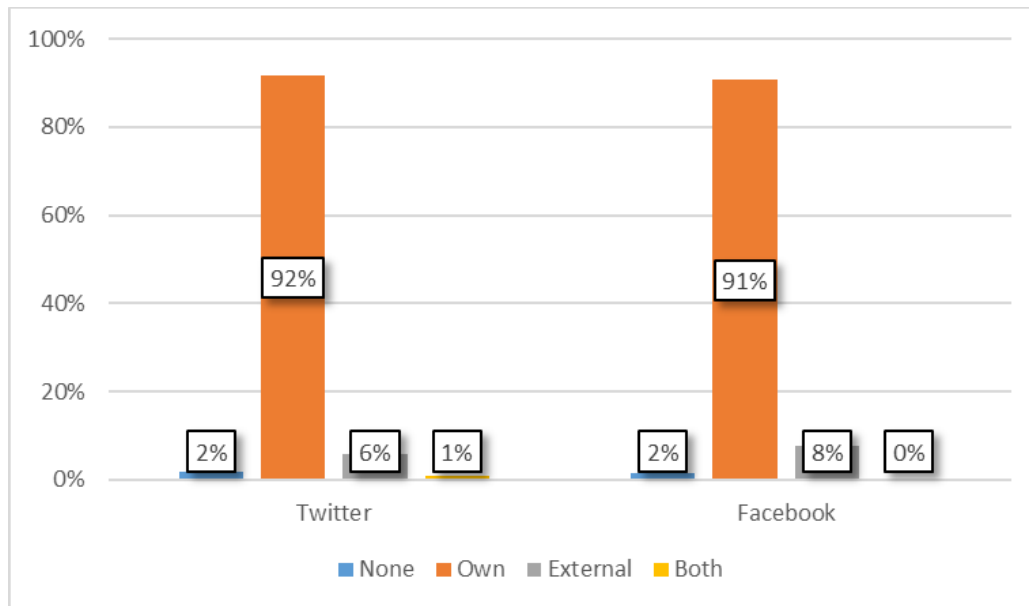
Source: Authors' own creation N=232

Although these are mostly media with presence in paper version, we detected that only 17% of posts invite to purchase the analogical version. They all generally offer the complete content in an open and free manner on the Internet and only in specific cases news are cut, representing only an advance of the paper edition.

**Figure 8. Presence of promotion**
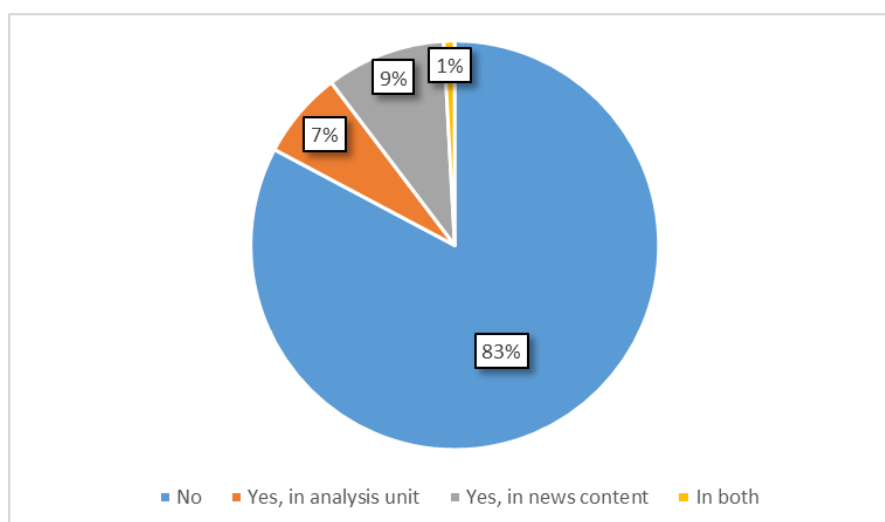
Source: Authors' own creation N=232

However, there are noticeable differences between magazines. *Muy Interesante*, which posts do not refer to contents in paper version, has an enormous amount of online contents. Paradoxically, this magazine is the one that more followers and publications gathers. In this sense, there is the possibility

that their news' content can be re-used, since it is not dated. In the case of *Quo* and *National Geographic,* 3.5% of publications analyzed publish the printed edition. On the contrary, *Enigmas* promotes paper in 45% of cases; followed by *Investigación y Ciencia* with 43%; and *Año Cero* with 27% of publications.
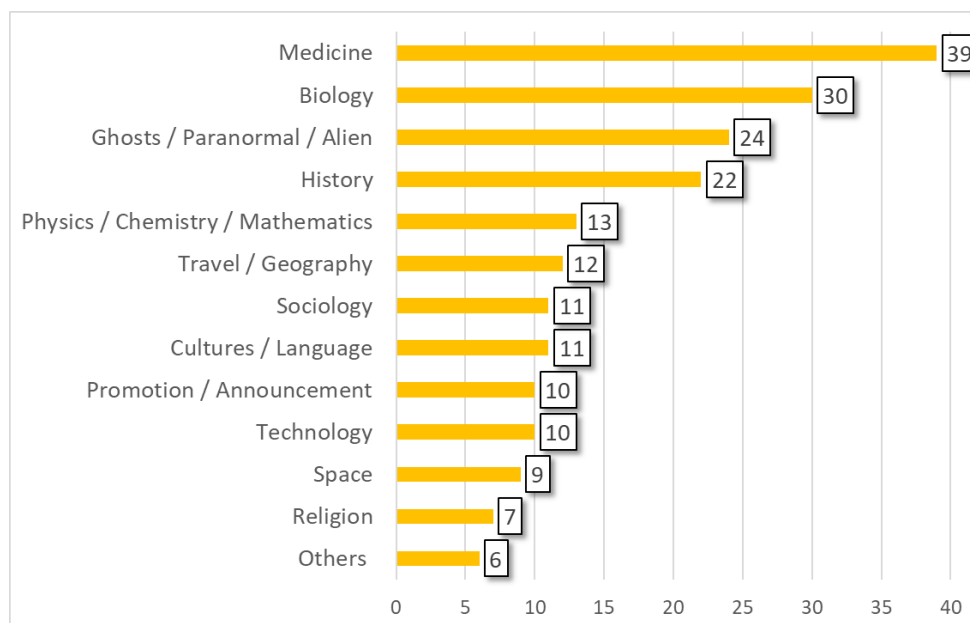
Figure 9. Magazine and presence of promotion
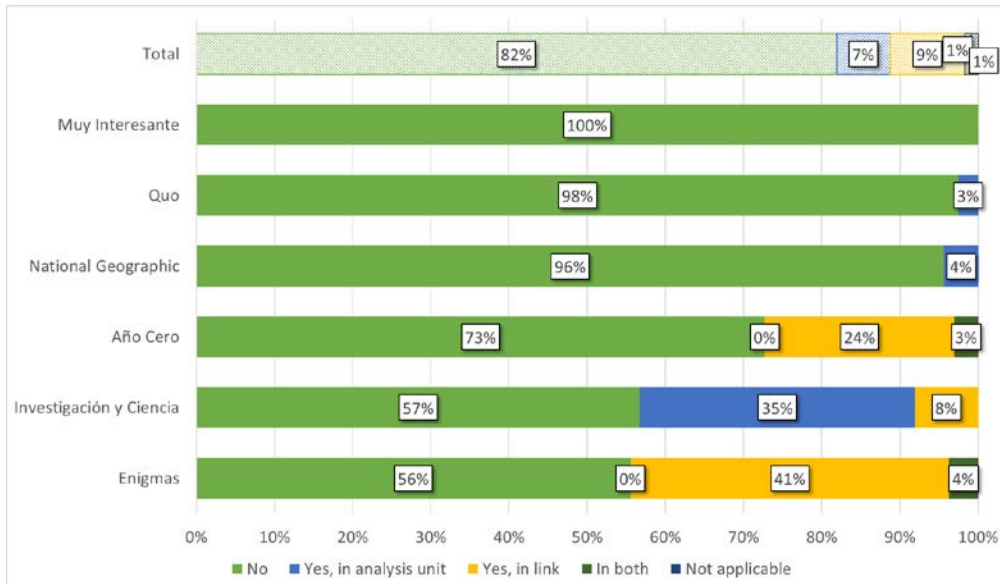
Source: Authors' own creation N=232

4.2 Informative treatment

**Figure 10. Main topics of news**

Source: Authors' own creation N=204

At thematic level, the topics about the called exact and natural sciences are abundant, such as medicine, biology, physics, chemistry or mathematics; while social sciences are left aside to less popular positions, such as sociology, culture or languages. In third place, however, there are news of magazines of more pseudoscientific nature, like *Año Cero* and *Enigmas*, which content mainly talks about ghosts, strange animals, aliens and paranormal phenomena. It is interesting that the topics related with outer space or technology occupy the last positions of the list.

Each magazine has a series of specialization areas (see figure 11). *National Geographic* outstands for treating issues such as travels, geography and biology. *Año Cero* is focused on phantasmagorical and paranormal. *Enigma*s is positioned in this same field, but to a lesser extent. *Muy Interesante* distributes its content between articles that mainly talk about medicine, space and sociology. And finally *Quo* focuses in topics like medicine, biology and sociology.

Figure 11. Distribution by topics and magazine
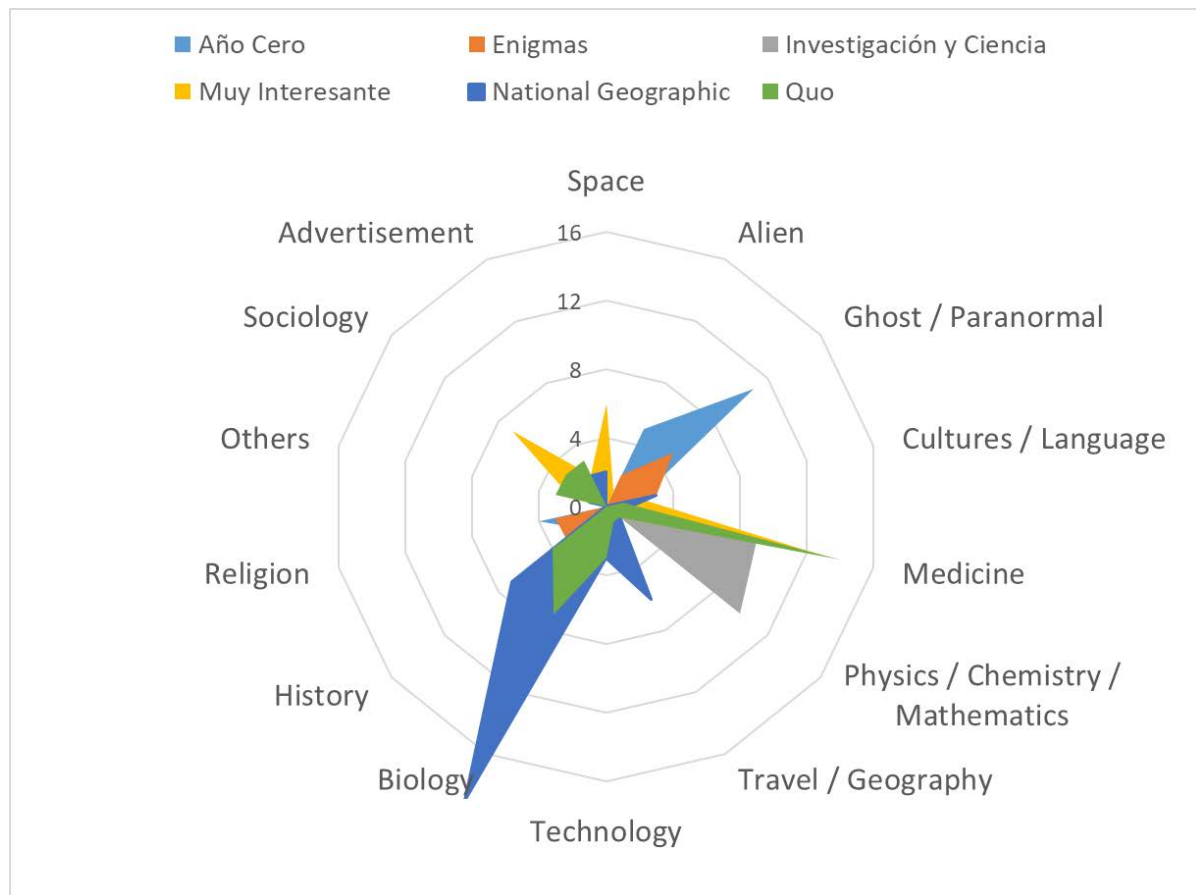
Source: Authors' own creation N=204

The informative function detected in analysis units also changes. More than half of publications, with 53%, have explanatory and informational nature statements. However, 24% are contents dedicated to attracting readers through messages that appeal to spectacle.

Figure 12 and 13. Distribution of informative function and magazine
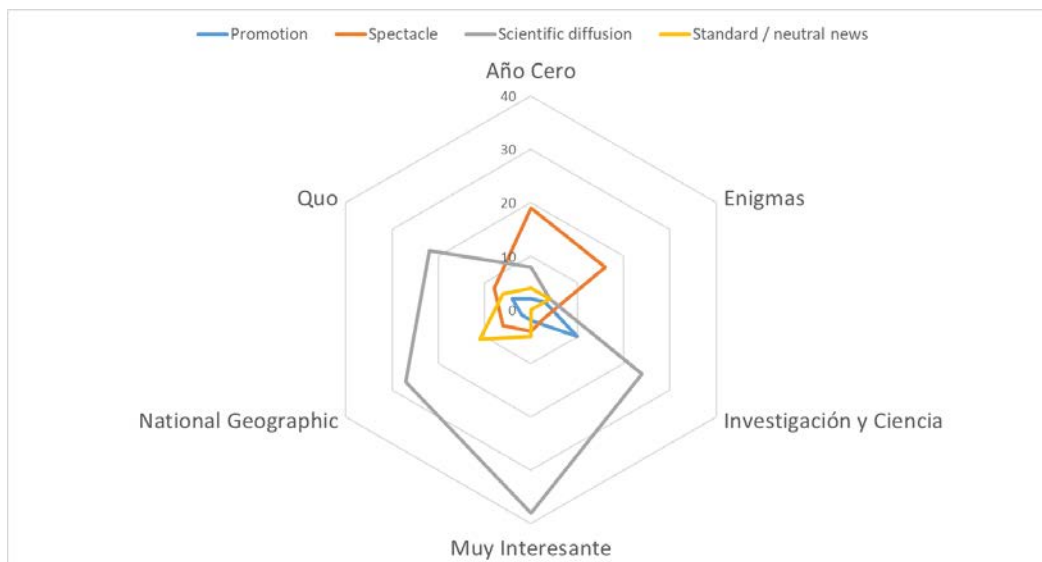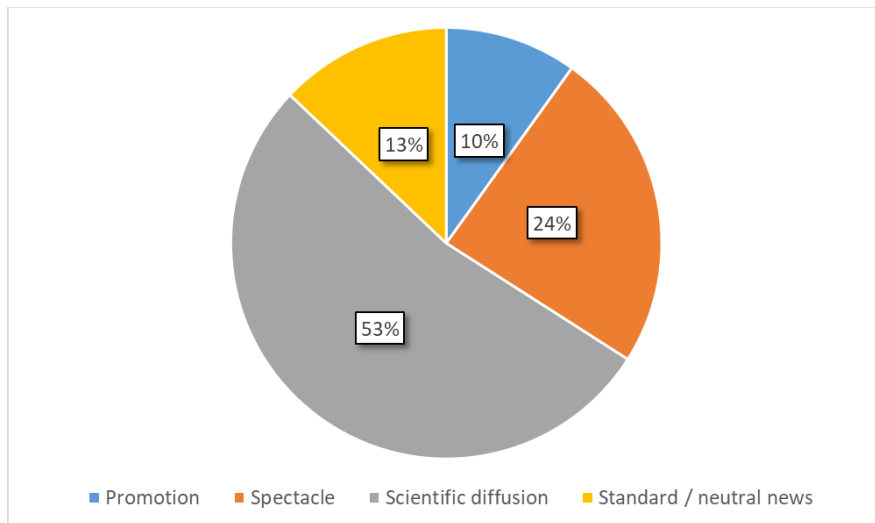
Source: Authors' own creation N=232

Some examples of sensationalist appeal observed: "#Video. New sighting of the Lake Norman's monster" (*Año Cero*), "Are birth marks a proof of violent death in past lives?" (*Enigmas*), "Can science predict how much sex you will have...but perhaps you don't want to know" (*Muy Interesante*), "This noise can get on anyone's nerves" (*Quo*).

Some examples of messages which main purpose is scientific diffusion: "Chemistry Nobel Prize 2017 to the parents of cryoelectronic microscopy that revolution biochemistry" (*Muy Interesante*), "A weekly hour of #exercise helps prevent #depression" (*Investigación y Ciencia*) or "The Borgia Codex takes us into the knowledge reached by other cultures" (*Enigmas*)

Regarding qualitative observations, the detection of covert advertisements' cases are worth mentioning. For instance, aforementioned Mazda's documentary linked to *Quo* magazine. Another type is the advertisement content undercover as information such as the news on the web of *Muy*

Interesante [5] about a new car model or the sponsored content of Twitter about hair fall (see figure 14).

Figure 14. Examples of sponsored content

Source: Web and Tweet of *Muy Interesante*

17% of units analyzed use formulations or purely specific words in the scientific field; while 83% use a common language. There are differences among magazines. *Investigación y Ciencia* leads the list in the use of specific language in its *posts*. Textless publications, that do not have any kind of introductory headline (for insance, a tweet comprised by a single web link) are scarce and observed only in the case of *National Geographic*.

**Figure 15. Distribution of language and magazine**
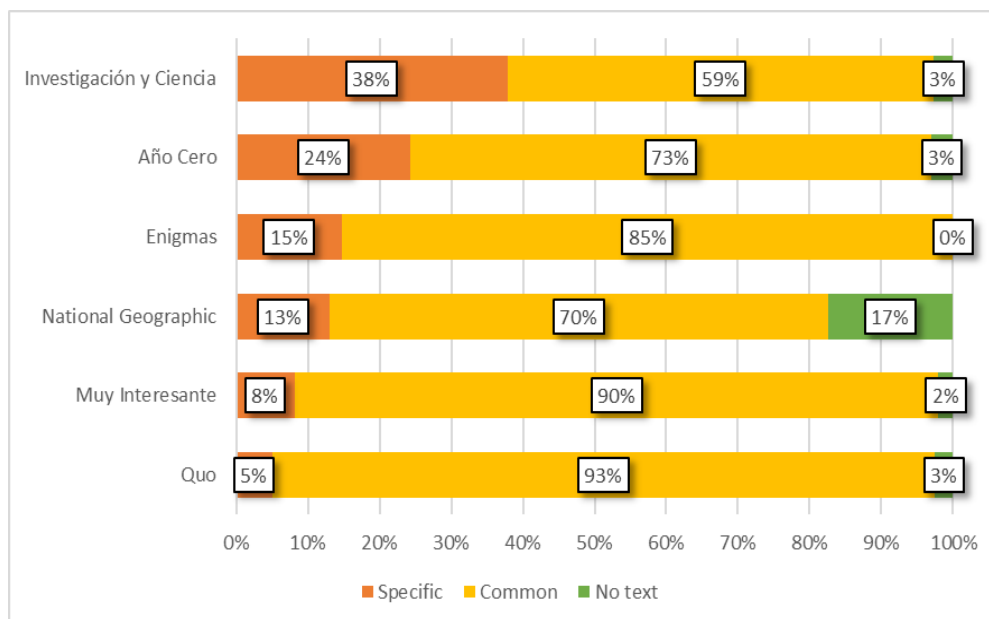
Source: Authors' own creation N=232

Regarding the writing style, 9% of analyzed units are written in first person (16 news out of the total of 174 news). In this sense, social networks such as Instagram and YouTube are excluded from the sample. The use of first person narration varies: *Año Cero* (6), *Investigación y Ciencia* (6), *Muy Interesante* (4), Enigmas (3), *Quo* (2) and *National Geographic* (1). Regarding the news authorship, a great percentage of them do not have a clear signature. No author in *Quo* (70%) leads the list, followed by *National Geographic* (58%). In the remaining publications the percentage drops below 50%. As indicated before, it is not usual that the journalist is mentioned in the post. Reference to authorship is detected in 7% of cases corresponding to single news (n= 204).

As a qualitative appreciation, it is worth mentioning that certain authors leader a great number of analyzed texts. This aspect evidences that journalists' headcount is rather reduced. *Año Cero* and *Enigmas* share the author Josep Guijarro. The author Sarah Romero wrote 59% of authored publications in *Muy Interesante*. In the case of the 13 news with authorship of *National Geographic*, most of them are signed by Alec Frossman (78%). In *Quo's* case, Vicente Fernández wrote 73% of all news with authorship.

**Figure 16. Mention of journalist by magazine**
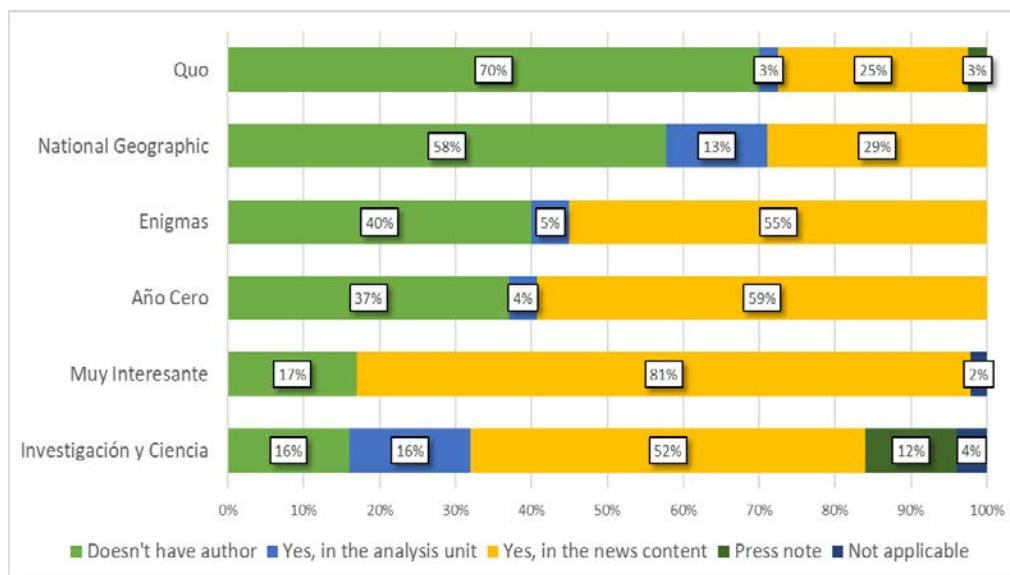
Source: Authors' own creation N=204

Regarding the informative treatment of audiovisual information, there are relevant aspects to be analyzed, both qualitative and quantitative. There is a positive coherence between text and image in 87% of cases. However, in 13% there is not. The social network YouTube and posts without image are excluded (n=215). Besides, in 53% of cases there is no reference to images' sources in the news contents. Only 16% are images belonging to the media. 31% are cited as external cessions. We exclude from the percentage, those cases where this variable cannot be applied (n=199). On the other hand, most are standard images, pictures without editing that capture reality (45%). *Muy Interesante* mainly uses those belonging to image banks (47%), which aesthetic is not very real and of commercial nature. In the case of *Año Cero* and *Enigmas*, photomontages (combination of two or more images) is detected in 23% and 26% of cases, respectively. *Investigación y Ciencia* uses illustrations, drawings and animations in 22% of cases, such as organs' 3D graphics.

These qualitative observations can be illustrated through the magazine *Enigmas*. The first case shows the misuse of an image, which source is incorrect; and the second one modifies the image content to resemble a different content.

Figure 17. Typology of images in analysis units
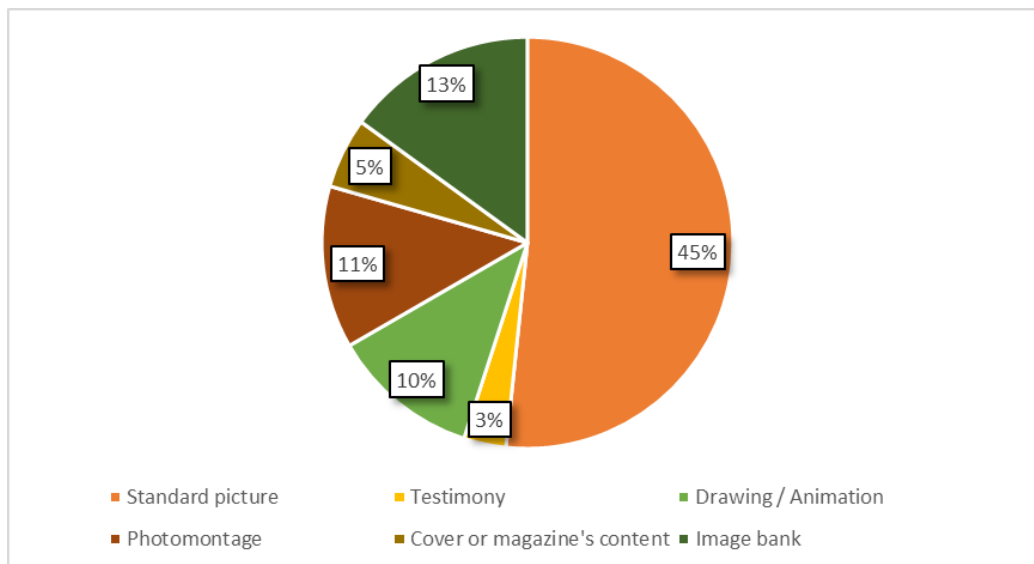
Source: Authors' own creation N=205

In example 1 (figure 18) authors use an image of the skull column from the Genocide Museum of Tuol Sleng (Cambodia) to illustrate an archeological discovery linked to Aztecs. Authors of the magazine *Enigmas* do not cite the image source.

Figure 18. Magazine *Enigmas* example 1

Source: newmatilda.com and magazine *Enigmas*

The second example, is about a horizontal rotation of the image, where the text appears as a mirror, seeming like a different content for Facebook and Twitter.

Figure 19. Magazine *Enigmas* example 2

Source: Twitter and Facebook accounts of magazine *Enigmas*

5. Discussion and conclusions

Results show that exploitation of the digital scenario's communicative possibilities is quite elementary. In this sense, we do not detect a work of message's adaptation to the specificities of each one of the Web 2.0 platforms. This aspect is quite eye-catching to the extent that studies indicate that citizens get informed about science and technology mainly through these (Fecyt, 2017). Therefore, we suggest the need to define guidelines for the production of online contents that make the most of the specific features of each platform. Among other aspects, this weakness is observed in the reduced use of hashtag on contents published on networks like Twitter or Instagram. This lack of tags impacts negatively users' browsing options as well as media itself, because it limits their options of promoting or viralizing their messages. In conclusion, we can highlight the following aspects:

- **Predominance of visual attributes:** The research developed allows to identify a consolidated trend to include visual resources (specially of photographic type) in disseminated messages. Nevertheless, publications have not exploited in a wide and varied manner other kinds of resources beyond pictures, such as audiovisual or info-graphics. Therefore, we suggest the milestone of diversifying messages composition with other kinds of attributes of visual type.

- **Abundance of images bank resources:** Just as we concluded, pictures have a leading role in publications. However, the analysis detected a heavy use of material coming from image banks, or to a lesser extent, the appropriation of contents from other Internet websites. This aspect, strictly linked to operative and economic aspects, has a clear impact in the qualitative value of contents and opens a mandatory reflection in the sector about the need to potentiate their own contents.

- **Need to improve reference to sources:** Regarding the two previous topics, the study allows concluding that publications must improve the treatment of sources of visual resources included in their contents. The absence of quotes or references is generalized, especially in most pictures incorporated to contents.

- **Social networks and audiovisual contents:** The study observed a reduced use of visual contents in the digital ecosystem of analyzed publications. We evidenced how videos linked with the main headline are barely distributed on social networks. Thus, the viral capacity of these social platforms is underused.

- **Absence of a solid strategy for social media:** Regarding the previous issue, the study warns about another aspect of great relevance linked to the need of defining communicative strategies adapted to cyberspace or specific plans for social media. Magazines of the sector must be able to adapt to a communicative scenario where the video is acquiring a greater leading role over time. In this same line, it is possible to conclude that the use of Instagram should be potentiated, because only some publications such as *National Geographic,* present on Instagram and Snapchat, show hints of a deep and mature bet on these kinds of platforms.

- **Use of links and emojis:** Likewise, the lack of a writing strategy of contents adapted to cyberspace is observed in the use of links or emojis (with only 3%). New media should adapt to the multimodal communication systems that prevail among citizens more and more. Magazines of themes related to science should bet on a style in their contents for social networks that responds to these new trends of the sector.

- **Bet on data journalism:** Exploitation of statistical data with more appealing visual strategies is another aspect to be improved. The inclusion of info-graphics in articles would help understand concepts with less difficulty. Likewise, the use of data and statistical analysis is nonexistent. This way, data journalism resources would allow a better visualization of data presented in news.

- **The danger of covert advertisement:** the practice of covert advertisement should be eliminated from these kinds of publications both due to the type of themes they handle as well as due to their public's profile. In most cases, advertisement practices are simply indicated with a hashtag (like: #sponsored or #promotion) in Twitter's case. In the web's case, it is interesting that, in general, the promotion is introduced as another news and its nature is highlighted with the inclusion of a headline (for instance: "*Muy Interesante* for Mazda"). This aspect is related to the few news signed by their authors, where information sources are not explicit and the inadequate use of images, such as the example of the news about an archeological Aztec Discovery illustrated with an image about a conflict in an Asian country, invites to reflect about how the digital conversion of press has promoted fake news.

- **Improve visibility:** At strategic level, online information of studied contents does not tend to publish nor indicate a pre-visualization of the printed edition. This aspect directly impacts the general feasibility of the media in the sense that, if these do not improve the visibility of the printed magazine, it is possible that its existence could be at stake.

In conclusion, the study points out the relevance of improving the adaptation of these publications' contents to the specificities of the digital scenario with the purpose, on one hand, of generating more

eloquent, profitable and persuasive informative messages for Internet users; and on the other, to offer a more interesting feedback at communication and business level to said magazines (both in their printed and digital editions).

6. Notes

[1] Both the universe and the raw sample, as well as content analysis done by researchers is available in the following link:
https://docs.google.com/spreadsheets/d/1E7ZMqbb9ublBLAu4lbLl0iwsbCzMATna_-PMFWuimIE/edit#gid=971622878

[2] It is worth mentioning that in the case of analysis units of online news, we analyzed the heading and subheading separated from the news content.

[3] See publication: https://www.facebook.com/QuoRevista/videos/1755786404455906/

[4] YouTube publications were excluded.

[5] See: https://www.muyinteresante.es/tecnologia/articulo/mazda-cx-5-perfecta-sencillez-851505736208

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