

Estudios sobre el **Mensaje Periodístico**

ISSN-e: 1988-2696

<https://dx.doi.org/10.5209/esmp.72837> EDICIONES
COMPLUTENSE

Understanding the Lack of Science on Tv: Network Decision-Makers' Opinions towards Televisual Science¹

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Recibido: 3 de diciembre de 2020 / Aceptado: 28 de octubre de 2021

Abstract. The lack of science on the Spanish TV is explained through the people responsible for content production, scheduling and offer. Two focus groups made up of five decision-makers identified the professionals' opinions: science on TV is needed, the function of televisual science is educating audiences, public channels are responsible for showing such contents, government should urge scientific programming, science on TV contributes in increasing the cultural level of audiences, and people holding power positions are not interested in improving society's level of literacy. Later, the generality of those opinions was measured through a questionnaire applied to 450 TV managers. A latent profile statistical analysis showed that individual characteristics of professionals (i.e., gender, age, educational level) do not play a role in shaping their opinions but work related (i.e., area of coverage, TV ownership) do.

Keywords: Science communication; opinions; attitudes; TV Managers; Science on TV; Spanish TV.

[es] Comprendiendo la falta de ciencia en la TV: opinión de los responsables de las cadenas sobre la televisión científica

Resumen. La falta de ciencia en la televisión española puede ser explicada mediante las personas responsables de la producción, programación y oferta de contenidos televisivos. Dos grupos focales formados cada uno por cinco personas responsables de tomar decisiones sobre dichos aspectos en cadenas televisivas permitieron identificar sus opiniones: la ciencia en la televisión es necesaria, la función de la ciencia televisiva es educar a la audiencia, las cadenas públicas son las responsables de mostrar contenidos científicos, el gobierno debería obligar a programar contenidos científicos, la ciencia en la televisión contribuye a aumentar el nivel cultural de la audiencia, y las personas que ocupan puestos de poder no están interesadas en mejorar el nivel de alfabetización de la sociedad. Posteriormente, la generalidad de esas opiniones se observó mediante un cuestionario aplicado a 450 personas con cargos directivos de televisión. Un análisis estadístico de perfil latente mostró que las características individuales de los profesionales (i.e., el género, la edad, el nivel educativo) no influyen en la formación de esas opiniones, pero sí influyen los aspectos relacionados con el desempeño profesional (i.e., el área de cobertura, la titularidad de la televisión).

Palabras clave: comunicación científica; opiniones; actitudes; directivos de televisión; ciencia en televisión; televisión en España.

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Cómo citar: Soto-Sanfiel, M.T., Villegas Simón, I., & Angulo-Brunet, A. (2022). Understanding the Lack of Science on Tv: Network Decision-Makers' Opinions towards Televisual Science. *Estudios sobre el Mensaje Periodístico* 28 (1), 621-637. <https://dx.doi.org/10.5209/esmp.72837>

1. Introduction

The presence of science in the media has already been studied from the perspective of journalism (Besley & Tanner, 2011; Poliakoff & Webb, 2007). However, newsroom staff are not the only employees of media companies who influence the content that is broadcast. Specifically, in terms of television, producers, managers and executives also decide what content to show (Jones, 2011). In fact, scheduling decisions are usually made at

¹ Acknowledgements. The authors are grateful to all of the TV professionals who kindly participated in this study.

This research has been funded by Spanish Foundation for Science and Technology (FECYT). Reference: FCT-15-9831.

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the senior management level, from where conditions are imposed that limit the options for production and creation at lower levels of the hierarchy (Löffelholz, 2009). Despite this, there has been very little study of the relationship between TV schedulers, directors, producers, managers, and screenwriters with science and scientific content.

The academic literature notes that the association between the supply and demand for television content is a reflection of the relationship between media professionals and their viewers (Lehmkuhl, 2014). Studies of the TV industry suggest that professionals in executive positions are credited with being especially talented at understanding their audiences (Draper, 2014). They obtain this knowledge from market research data, by internalizing the creation-production ideologies imposed by their networks and their superiors' expectations of them, and through their familiarity with industry standards. This perceived awareness of their audiences influences their behavior and attitudes, but might also imply the hegemonic maintenance of certain types of content (Draper, 2014), and reproduce established production patterns (Caldwell, 2008) that are subsequently reflected in what goes on air (Havens, 2013).

Research has also consistently shown that television producers prefigure or theorize about their audiences (Dornfeld, 1998; Caldwell, 2008) and use these mental images of consumer habits, behaviors and preferences to guide their decisions in professional practice (Caldwell, 2008; Dornfeld, 1998; Gans, 1957; Pool & Schulman, 1959; Ross, 2014; Schramm & Danielson, 1958; Zafirau, 2009; Zimmerman & Bauer, 1956). A large number of these images stem from objective data obtained from market studies, but they can also be inspired by direct personal experiences (Gans, 1957). In fact, research has shown that the way TV managers define their audiences and make production decisions tends to be based on their own personal aesthetic considerations and limited social circles (Gitlin, 1983; Ross, 2011a; Zafirau, 2011), whereby such professionals view audiences as they view themselves and use their own preconceived beliefs and intuitive knowledge to decide what to air (Dornfeld, 1998; Zafirau, 2009) to the extent that they can be reluctant to process and accept new information about their audiences (Zimmerman & Bauer, 1956) or learn more about them (Brake, 2009). As a matter of fact, television executives believe in their capacity to spot quality, to train and educate audiences, to recognize what is good for their broadcasting company, to analyze and interpret ratings and to take decisions (Kuipers, 2012, p. 20). Indeed, television producers take decisions after considering their budget, team's skills, available resources and the expectations of the broadcasting company about the final show. The creative possibilities surrounding television producers vary within the audiovisual sector (Tunstall, 1993). Finally, gender and ethnical background are also influential variables within the television creative process which affects topics and treatments of television shows. Television professionals reflect their own characteristics on the aesthetics of their audiovisual production (Henderson, 2001).

In short, producers tend to create the kind of television that they personally like to watch (Hesmondhalgh & Baker, 2011), despite claiming to judge, speak and act on behalf of the viewers (Ross, 2014), who often belong to very different demographic groups to their own (Zafirau, 2009). In addition, when the media targets specific issues and broadcasts a certain kind of content, this very choice of content can go on to influence audience behavior and shape their own interests (Corbett & Mori, 1999).

1.1. Science on Television

Science on television has been extensively studied for its educational potential (Ezquerro, 2003, 2007; Ezquerro & Pro, 2006; McSharry & Jones, 2002; Perales, 2006). Some studies have observed the informative nature of science-based content on TV, as well as its appeal to audiences, especially younger viewers (Moya & García Molina, 2013), particularly focusing on the way science and scientists are represented on TV (Leon & Erviti, 2013) and how this affects the way children view science. Therefore, research has also been conducted on televised science as an educational resource for use in schools.

Moreover, the study by Lehmkuhl, et al., (2012) explores which factors affect the volume and structure of science on TV in the European market. The authors have identified three main aspects: a) Segmentation/fragmentation of television markets; b) The presence of medium-sized commercial channels, and c) The dependency of public service TV channels on commercial revenue. Regarding Spain, these authors note that public television is so exposed to market forces that the amount of scientific content aimed at large audiences is particularly low. However, there has been little in-depth study about the role of the professionals who produce, create and broadcast such scientific content, and observation has usually focused on the journalistic perspective.

The aforesaid are the motivations for this study of the relationship between the people who run TV networks and science. The responsibilities of professionals such as managers, screenwriters, producers, directors and/or schedulers include the design, production and airing of successful shows that their audiences will enjoy. The available literature maintains that these professionals are responsible for the presence of science in the media (Soto-Sanfiel & Latorre, 2014; Soto-Sanfiel & Villegas, 2018) and that it is by no means the exclusive competence of newsrooms, whose main purpose is to cover current affairs. Science can also inspire shows in other genres (e.g., fiction, reports, interviews and documentaries) for a variety of audiences and for different reasons (e.g., entertain, inform and disseminate). The creative and market potential offered by science for creating content therefore depends on the attitudes to the subject among professionals with decision-making capac-

ity, and also on their perceptions about what audiences think of science. Hence this study raises the following research questions:

- RQ1: What kind of opinions do television professionals hold in relation to scientific dissemination on TV?
- RQ2: Are those opinions related to the type of firm, the professional area and the ownership of the firm the television professionals work for?
- RQ3: To what extent do individual characteristics shape their opinions?

The ultimate goal of this research is to enhance our understanding of whether these opinions are unfavorable towards increased production and broadcast of science-based television.

The study was conducted in Spain, a country where science is not a prominent feature on TV screens (Soto-Sanfiel & Villegas-Simón, 2018), with very little scientific content on the news or in its shows (Grosso, 2017; Gutiérrez, 2002; León, 2002; Moreno-Castro, 2010; Revuelta & Mazzonetto, 2008). In fact, Spanish audiences do not believe that TV networks are interested in covering science and that there are other forms of media that are more suited to the topic (FECYT, 2015). There are a variety of reasons for this. Some are structural, alluding to the marginal role of scientific knowledge in the recent history of Spanish society, the lack of state investment in R&D programs, financial crises and even the weight of the Catholic religion in Spanish culture and education (Cortiñas-Roviera et al., 2015). Other reasons for Spain's lack of interest in science relate to the media itself, such as the downsizing of staff, the variety of the offer and the awarding of television licenses on the basis of interests that are far-removed from those of the audience (Francés & Llorca-Abad, 2017). It has also been claimed that scientific content is unprofitable (León, 2002; Lehmkuhl, 2014), attracts limited advertising (Moreno Castro, 2004) and is unappealing to Spanish audiences (Cortiñas-Roviera et al., 2015). All of the above could explain the attitudes to science among senior Spanish TV decision-makers, who form part of that same professional and social culture (Ross, 2014).

1.2. Media professionals and science

There has been limited academic study of the relationship between Spanish television professionals and televisual science-inspired content. Soto-Sanfiel & Latorre (2014) observed the attitudes to science among final-year students on an Audiovisual Communication degree, who were about to seek employment in the Spanish media. The study observed the subjects before and after taking a course on the production of radio shows of all genres on the topic of science. In Spain, audiovisual communication students are trained to create, produce and direct content

for all genres of radio, television and multimedia, and also to work in the management of media companies. Such graduates are the natural employees of the Spanish media industry.

Based on the theory of reasoned action (Ajzen & Fishbein, 1980) and its development, the theory of planned behavior (Ajzen, 1985), the research assumed that those students' attitudes towards the production of science-based media, subjective norms learned about the nature of media work and the perception of their ability to understand and master the creation of scientific content could be predictors of their intentions to work with science during their professional careers. The results of the study confirmed that the students agreed that society needs to know about science, but they were also extremely skeptical about the suitability of science for media creation and consumption. They found science difficult, dull and inaccessible, felt it required much more documentary research than other sources and thought it was much harder to adapt science to media production routines, languages and audiences. According to the participants, scientists do not understand the peculiarities of the media industry, which makes it even harder to produce this kind of content. The difficulty in understanding scientific content also produced negative feelings, and they felt that it could be humiliating or frustrating to appear ignorant in comparison to their scientific sources. After taking the course, and despite saying that they enjoyed it, the students preferred to continue working with other sources of inspiration, particularly those related to entertainment and the arts. The researchers stated that those attitudes were so strong that they were highly unlikely to shift towards a more positive view of science in the media, and recommend that a greater love of science should be fostered at earlier stages of the education process (Soto-Sanfiel & Latorre, 2014).

Another study explored the attitudes of employees of Spanish TV networks of different scales (local, regional and national) and ownership (public, private and mixed) to scientific communication (Soto-Sanfiel & Villegas-Simón, 2018). The sampled professionals felt that science has a highly specific audience and that its viewers seek scientific information on media other than television. However, they did agree with the expressive potential and social benefits of the creation of scientific content for TV, despite it only having a minority audience. The researchers therefore recommended future studies to throw additional light on the views of Spanish TV professionals about the commitment of television with scientific dissemination, and on the perceived effects of televised science on the cultural level or knowledge of citizens. Consistent with the previous literature, the researchers believed that, if confirmed, this might help to explain the limited presence of the topic in the country's media and, consequently, in Spanish society. This research is a response to that suggestion.

2. Method

To achieve the goals and answer the research questions, this study adopts a mixed-method approach consisting of two phases and data collection techniques (Creswell, 2003; Creswell & Plano Clark, 2007). The first phase is qualitative and consists of two focus groups made up TV employees with creative, production and content scheduling responsibilities. The sessions served to elicit opinions, attitudes, and beliefs (Osborne, Simon & Collins, 2003) about the production, offer and scheduling of science on TV. These opinions were used to formulate a questionnaire that was applied in the second, quantitative, phase that checked how widespread these opinions are. This involved a convenience sample of professionals from Spanish TV networks in different regions, and of varying ownership and scale. The research design responds to the absence of instruments to define and measure the attitudes of TV professionals to the topics discussed.

2.1. Phase 1: focus group

2.1.1. Participants

Each of the two focus groups involved five active male senior decision-makers of TV networks, none of whom were paid for their time. The members of the first group were from local television, and in the second, they were from national networks.

2.1.2. Procedure

In both focus groups they were asked questions derived from previous research on attitudes to science (e.g., Cortiñas-Rovira et al., 2015; Lehmkuhl, 2014; Lehmkuhl et al., 2012; León, 2002; Moreno Castro, 2004; Soto-Sanfiel & Latorre, 2014) and the available literature. Methodologically speaking, the focus groups followed a semi-structured dynamic. The researchers prepared a set of questions to promote and guide the discussion about a varied of themes: the adequacy of television language for presenting science content, the role of television professionals in including science on the audiovisual offer, the degree of satisfaction with the current presence of science in Spanish TV, the role of public and private televisions on promoting science, the effect of consuming science contents on audiences, and the responsible actors for lack of science on TV. Other factors emerged spontaneously from the discussions.

2.1.3. Data Analysis

The focus groups were recorded and transcribed word-for-word. During the first phase, content analysis was subsequently applied to the transcripts of the focus groups using the Atlas.ti software package. Following Onwuegbuzie, Bustamante, and Nelson, (2010), the analysis used: 1) inductive codes, taken from the preliminary literature and the topics

and opinions addressed in the focus groups, and 2) deductive codes, which arose from the transcribed text itself, mainly due to the repetition of the topic or opinion, the controversy generated between the participants and/or how emphatically they expressed their feelings (Morgan & Krueger, 1997).

The codes were analyzed across several phases in which they were inter-related and re-coded, and eventually filtered down into the items of the questionnaire applied in the second phase.

2.2. Phase 2: response analysis

2.2.1. Participants

In the study participated 450 employees of companies from six different regions of Spain [i.e., Andalusia ($n = 79$), Canary Islands ($n = 2$), Catalonia ($n = 159$), Extremadura ($n = 49$), Galicia ($n = 21$) and Madrid ($n = 137$)]. Of these, 50.4% were men ($n = 227$), 46.7% ($n = 210$) women and 2.9% ($n = 13$) did not reveal their gender.

2.2.2. Materials

As indicated, the *ad-hoc* questionnaires included 17 items in the form of statements that reflected the attitudes, perceptions and opinions of the members of the focus groups with regard to the production, offer and scheduling of scientific content (Onwuegbuzie, et al., 2010). The participants expressed their agreement with the statements on 5-point Likert scales ($1 = Totally agree$, $5 = Totally disagree$). For example: "Television channels dedicated to broadcasting scientific contents are needed". Figure 1 presents a short version of the items content.

Participants were asked to report their gender, level of education, previous work in the production or broadcast of scientific content (familiarity), position (managerial/organizational or production/creation), type of firm (TV network, media producer, or both), ownership of the firm (public, private, mixed) and area of coverage (national, regional, local).

2.2.3. Procedure

Before the questionnaire administration, a pilot test was conducted with a similar group of professionals, in order to assess the adequacy of items and the feasibility of data collection.

The researchers visited the offices of national and regional networks (Canal Sur, Canal Extremadura, Telemadrid, Televisió de Catalunya, Televisión Española, in Madrid and Barcelona, Televisión de Galicia and Televisión Canaria) and local networks (Barcelona TV, Mataró TV, Televisió a l'Hospitalet; Televisión de Badalona; Televisió Sant Cugat) to request the collaboration of the employees with decision-making capacity with regard to the content that is produced and aired as required by the sample criteria (i.e., schedulers, producers, screenwriters, directors,

managers). The management of each firm helped the researchers to identify the most suitable candidates, and the questionnaires were answered in private.

2.2.4. Data Analysis

All the statistical analyses were done with R (R Core Team, 2020). We performed a latent profile analysis (LPA) to evaluate the best model considering lowest Bayesian information criterion (BIC) and the lowest integrated complete-data likelihood (ICL, Biernacki et al., 2000). As there was presence of missing data in some variables (0.01%), we imputed missing values using the package mice (van Buuren, Groothuis-Oudshoorn, 2011) and standardized mean values previous to LPA. In order to study the demographic characteristics of the profiles, we drew up contingency tables and performed a Chi-squared test when the application criteria were met. In the case where criteria were not met, we applied the fisher test. Cases with unknown data in sociodemographic data were excluded from our analyses. We performed analysis of variance on the quantitative variables (age and experience). Inferences have not been made for those in the “Unknown” category. For that reason, the percentages shown in the annexes do not coincide with the ones presented in the figures.

3. Results

3.1. Phase 1: focus group

In the qualitative study, participants did not hold spontaneous and definitive opinions about the issue. The researchers who attended these sessions sensed that the participant professionals had somewhat vague views and several doubts regarding many of the proposed topics, suggesting that they were not matters to which they had given much previous thought. Moreover, these opinions varied very little between the groups, suggesting that further sessions would not produce a wider range of attitudes. In relation to the responsibility of broadcasting scientific contents on television, the participants stated that Spain needs television channels dedicated to broadcasting scientific content. They also considered that it is the responsibility of public television stations to broadcast such content. Moreover, they believed that the Spanish government should urge private television stations to broadcast quotas for scientific content since TV aims to educate. Indeed, they believed that media should improve the scientific literacy level of the population.

In terms of the consequences of broadcasting scientific contents on television, participants of the focus groups stated that scientific programs on television can contribute to raising the knowledge and cultural level in Spain. They also believed that television is not only a convenient medium for transmitting scientific information, but that it should explain the importance of science. They also considered that

it would be a plus for television to make that kind of scientific dissemination. Finally, they stated that showing scientific content on television makes television more educational.

Regarding the benefits of showing scientific contents on television, participants also considered that science can give rise to other perspectives and scientific facts must be able to explain how the world evolves. They also stated that scientific communication must emphasise the importance of university and promote scientific careers. Finally, they considered that the main objective of scientific dissemination is to educate people. However, participants also considered that people in positions of power act against the disclosure of certain scientific events on media. In fact, they consider that powerful figures in Spain are not interested in improving society’s level of scientific literacy. Those were the reasons for them, that explained the lack of scientific content on TV.

In summary, participants of focus groups consider the dissemination of science based contents by Spanish television to be a positive thing since it has the ability to improve the scientific literacy and education of the society. However, they also believe that people in power are not interested on increasing the scientific literacy of citizens.

All those opinions were transformed into 17 items that formed part of the questionnaire for assessment by the participants in the second phase. Indeed, the items are an exact reflection of all the issues that arose from the focus groups and therefore constitute a wide range of ideas that Spanish TV professionals spontaneously produce regarding the production, scheduling, and offer of science on TV. Figure 1 displays the items that resulted from this phase.

3.2. Phase 2: response analysis

We choose the EEV (ellipsoidal, equal volume and shape) model with three components because it was the one which showed the best performance: it had the lowest BIC (-19734.1) compared to the other two lowest BIC (EEE, 7 components, BIC = -19770.0; VEE 3 components BIC -19905.0) and the lowest ICL (-19734.8).

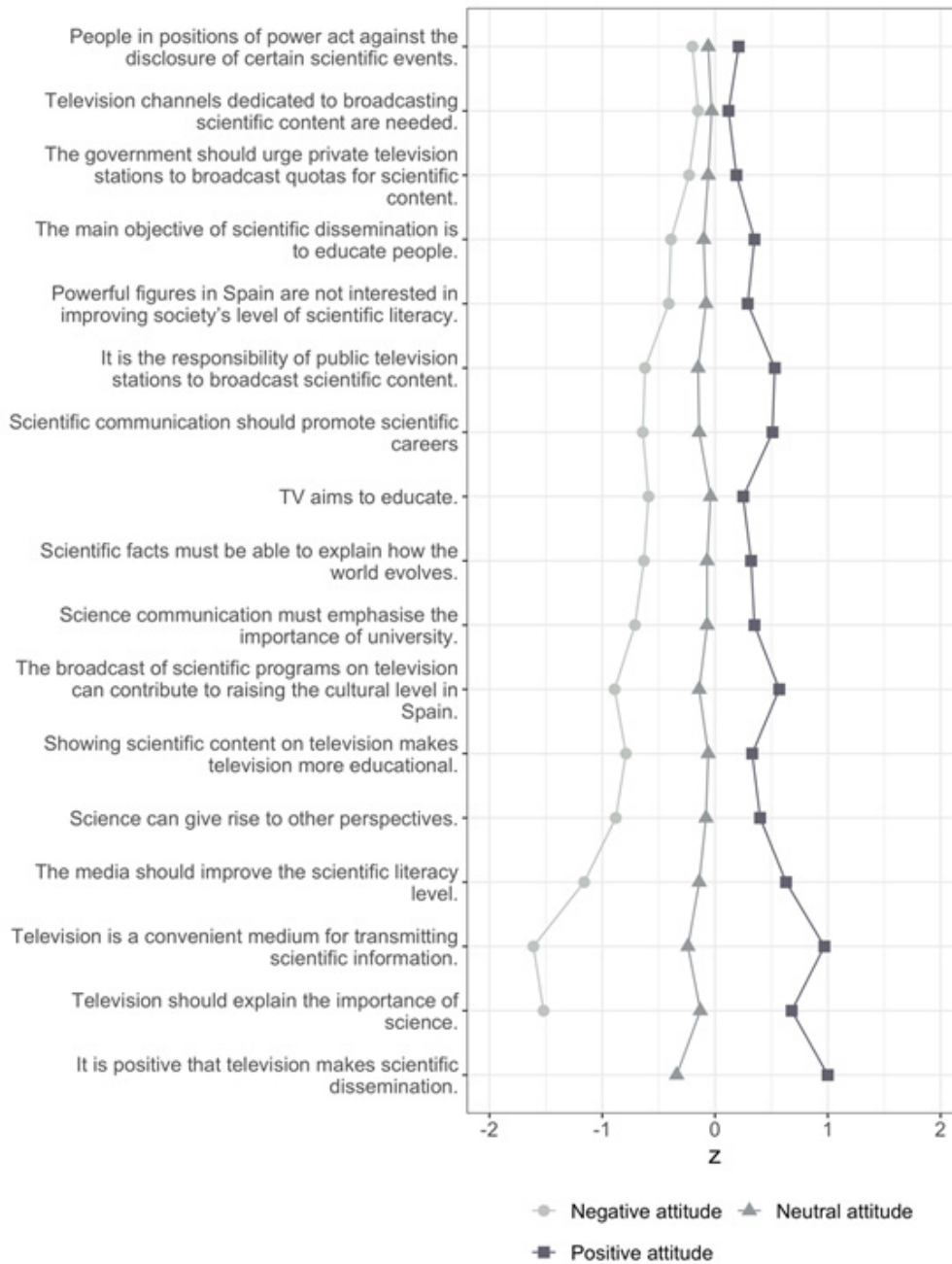
We identified three profiles of professionals (Figure 1; See Figure A1 for an alternative representation). On the x-axis we see the z-score represented. A z-score of 0 means that the score is exactly at the mean. On the other hand, a z-score of 1 means that the score is one standard deviation above the mean (in negative cases, it is below the mean). There is a first group of professionals who showed largely neutral opinions ($n = 296$, 65.8%), a second group who showed positive opinions ($n = 120$, 26.7%) and a third group who showed negative opinions towards issues related to science communication on TV identified on the focus groups ($n = 34$, 7.5%). As it can be observed, the largest group of the professionals of the sample have neutral opinions towards science communication on TV. Indeed, this group

accounts more than double of the second largest group, and the groups which had positive opinions. In turn, this second group of professionals with positive opinions is much larger than the third and last group, which shows negative opinions towards the issues related to science communication on TV. In sum, neutral attitudes towards science communica-

tion related issues on TV significantly outweighs (34.2%) the proportion of positive and negative opinions together (68.4%).

In order to evaluate the differences that exist between the different profiles, several hypothesis tests have been carried out, which can be found in Annex 1. The main findings are highlighted below.

Figure 1. Standardized Scores by Profile Group

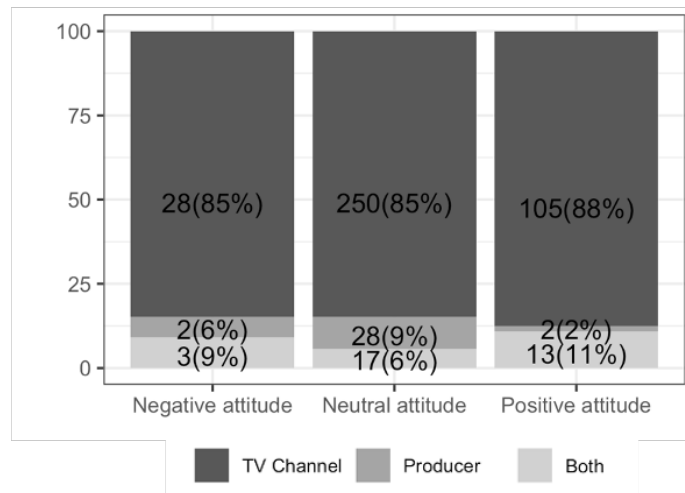


We found that the proportion of women and men in all the three groups were the same, which means there are no differences in their educational level either. There were also no differences between groups when considering age and years of experience in the firm. Thus, neither gender, education level, age, nor years of experience in the industry impacts the direction of the opinions towards issues related to science on TV of the professionals of the sample. Such

individual characteristics do not seem to affect the direction of the attitudes of the participants. They held positive, neutral or negative depending on other factors.

On the other hand, there were statistically significant differences in the type of firm the professionals work for ($p = .01$). As Figure 2 shows, those professionals holding a positive opinion work to a greater extent for both (TV Channel and Producer).

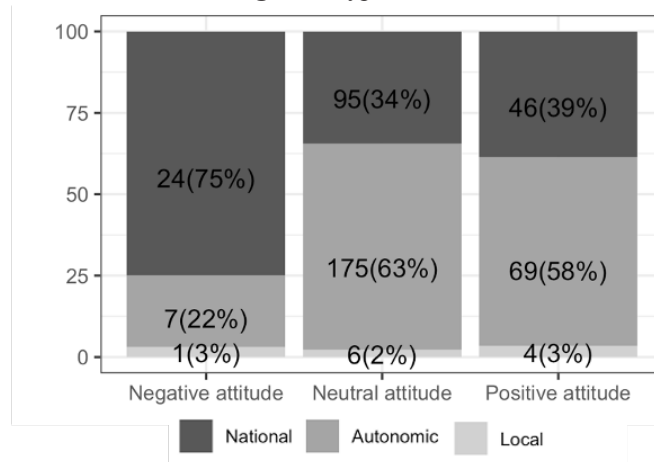
Figure 2 Type of firm



There were also differences depending on the coverage of the TV channel and the field the professionals work for (type of TV, (Figure 3, $p < .001$).

Professionals holding negative attitudes work to a greater extent for National TVs, than professionals holding neutral or positive attitudes.

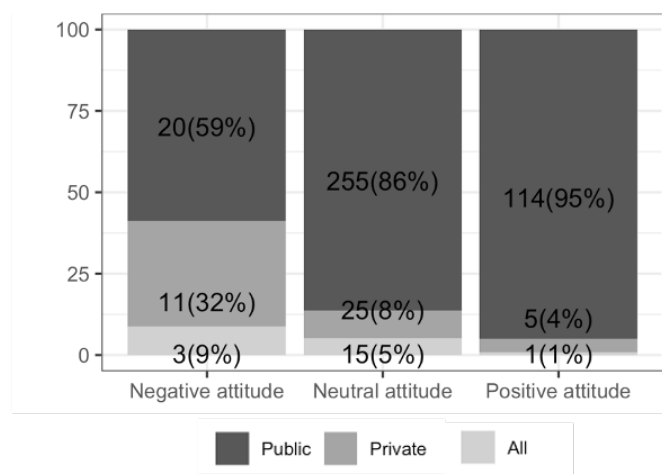
Figure 3 Type of TV



There were also differences in the ownership of the firm the professionals work for ($p < .001$, Figure 4). In the three profiles (positive, neutral and negative attitudes toward issues related to science on TV), more

than 50% of professionals work for a public firm. However, within the public firm industry, there are more professionals who hold positive and neutral opinions over negative opinions towards science on TV.

Figure 4 Ownership of the firm



Finally, there were no differences in the attitudes of professionals who were occupying different roles nor in their relation to the production area of the

company. Thus, the direction of the professionals' opinions do not depend on if they work for the production-creative or organizational-managerial area.

They also did not depend on their previous relation of the professionals with the production of scientific content (familiarity with them).

4. Discussion

This study has identified opinions to televised science among TV professionals with responsibilities for the creation, production and scheduling of TV content. Its purpose was to find explanations for the absence of science-based content on Spanish TV screens (FECYT, 2015; Grosso, 2017; Gutiérrez, 2002; León, 2002; Moreno-Castro, 2010; Revuelta & Mazzonetto, 2008; Soto-Sanfiel & Villegas-Simón, 2018). Until now, the role of science on TV has typically been studied from the perspective of journalism (Besley & Tanner, 2011; Poliakoff & Webb, 2007), but there are many others such as employees of TV networks who have a say in the kind of content that is aired on TV (Jones, 2011). Producers, owners, schedulers, directors and screenwriters also decide what goes into TV schedules. In addition to news and current affairs, science can also serve as the inspiration for audiovisual content in other genres, which are usually produced in departments other than newsrooms (Soto-Sanfiel & Latorre, 2014; Soto-Sanfiel & Villegas, 2018). This study seeks to fill these gaps in knowledge. Particularly, it seeks to provide useful information for understanding the reasons why science in Spanish TV screens is so scarce.

The results show that the sampled Spanish professionals have somewhat vague opinions towards the role of scientific dissemination on TV and the responsibility of TV on popular science, as previous researchers in the same context have also identified (Soto-Sanfiel & Villegas-Simón, 2018). In our qualitative study, participants did not seem to have strong, existing ideas on these issues. However, they agreed that television channels dedicated to broadcasting scientific content are needed in Spain. The perception about the lack of scientific content on Spanish television found in our research is consistent with existing academic literature on this subject (i.e., Grosso Mesa, 2017; Gutiérrez Lozano, 2002; León, 2006; Moreno-Castro, 2010; Revuelta & Mazzonetto, 2008).

Moreover, professionals of our sample stated that it is the responsibility of Spanish public television stations to broadcast scientific content. These attitudes might be related to the fact that, in Europe, airing science programs have traditionally been left to the discretion of public channels since commercial channels do not see economical value on broadcasting them (Lehmkuhl et al., 2012; Moreno-Castro, 2014). Indeed, according to the law, one of the main functions of the Spanish public broadcaster, Radio Televisión Española (RTVE) is in promoting scientific knowledge (Cano-Orón, Portales-Oliva & Llorca-Abad, 2017).

However, participants also considered that the Spanish government should urge private television

stations to broadcast quotas for scientific content. It is worth considering that there are regulatory mechanisms to obligate private televisions to meet the functions of audiovisual broadcasting services proposed by the regulatory framework, which includes promoting knowledge within society. For instance, the Spanish Private Television Law (10/1988, May 3) states that radio and television are a vehicle for informing, educating, and spreading cultural knowledge within the citizens.

Furthermore, participants on this study also reflected on the functions of science on television. They agreed that the main objective of scientific content on TV is in educating audiences, explaining how the world has evolved, to give rise to different perspectives when analyzing reality, stressing the importance of science, raising the society's educational and cultural level, and to emphasize the relevance of the current research efforts of universities. Consequently, these professionals believed in the necessity of understanding general issues related to science and technology as relevant competences of today's citizenship (Cámara, Muñoz, & López, 2017). Scientific knowledge has also been promoted by regional institutions: the European Union considers science popularization a priority within its countries (Cortiñas-Rovira, et al., 2015). As a matter of fact, the interest on scientific topics is related to the knowledge and education of societies. Unfortunately, Spain has been declared to be one of the countries with less than average knowledge, particular in women (Bauer & Howard, 2013).

Participants considered TV to be an adequate medium for transmitting scientific information and in improving the scientific literacy of its audiences too. In spite of that, the Spanish audience noted that present television does not pay attention to science information and that there are other more reliable media to learn scientific topics (FECYT, 2015). Indeed, there is not a close relationship between science and television in the country (Soto-Sanfiel & Villegas-Simón, 2018) for a variety of reasons including historical, structural, religious and economical constrictions (Cortiñas-Rovira et al., 2015).

Finally, professionals of the sample also considered that people in positions of power have to act against the disclosure of certain scientific events on TV and that powerful figures in Spain are not interested in improving society's level of scientific literacy. These opinions might be explained by the fact that Spanish society has shown an increasing disaffection and distrust towards politicians and authority figures in the recent years (Coller, Jaime, & Mota, 2016, 2019). In terms of media, Spanish media professionals and citizens note that politics tend to exert influence on media contents to satisfy their own interests (Alsius, 2010; Mauri-Riosm, López-Meri, & Perales-García, 2020; Rodríguez, López, Merino, & Mauri, 2017). Knowledge and information are considered to be decisive aspects of power, economy and richness (Castells, 2010).

Having considered the level of agreement with those opinions in a later quantitative study involving similar professionals, it was found that neutral attitudes towards those aspects significantly outweighed and almost doubled the proportion of positive and negative attitudes together. Neutral opinions refer to the items scored in the middle of the Likert scale, suggesting a lack of interest in, or little thought being given to those issues related to the presence of science on TV (DuBois & Burns, 1975; Edwards, 1946; Kaplan, 1972).

More specifically, results of the second study show that individual characteristics such as gender, education level, age, or previous professional experience do not affect the direction of the general attitudes towards the majority of the issues related to science on TV. However, variables related to the working environment area are influential. In fact, the type of audiovisual firm the professionals work for impacts the extent to what they show a positive attitude towards the identified topics related to communicating science on TV. Indeed, employees of TV channels show greater positive opinions towards the aspects related to the presence of science on TV than professionals who work for audiovisual production companies or for both.

The coverage area of the TV channel is also influential in the opinions of the audiovisual professionals. Those working for National TV show greater negative attitudes towards issues related to including scientific content in TV whereas those working for Autonomic TV channels show greater neutral or positive opinions towards them. This could be explained by the fact that the majority of the Autonomic TV channels participating in the sample featured only professionals who worked in public television channels. On the other hand, the National TV sample had professionals for both public and private television channels. Further studies, consequently, should confirm this result.

Also, results show the ownership of the TV channel is a relevant aspect. Within public TV channels there were more professionals showing positive or neutral opinions towards the issues related to showing science on TV than negatives than in the rest of the firms (private TV channels or audiovisual production companies). All of this is consistent with the study by Lehmkuhl, et al., (2012), which claims that the amount of science content on TV declines when market logic governs the way public broadcasters operate.

Finally, results show that these opinions are similar within professionals working for different areas of the audiovisual work. TV employees working both for the production-creation or managerial-organizational area show similar attitudes towards the identified aspects of the relationship of science with TV. Consequently, the opinions regarding science and television are not impacted by the previous experience of the professionals with science-based content TV program production.

In general, these results would be not just another reflection of the dearth of science in the Spanish media (León, 2002; Lehmkuhl, 2014; Moreno Castro, 2004), but also of the scant historic and structural importance of science in the country (Cortiñas-Roviera et al., 2015; Francés & Llorca-Abad, 2017).

5. Conclusions

This research has explored the views and attitudes of television professionals towards audiovisual science-based content in order to identify reasons for the lack of scientific content on Spanish TV.

This study was based on the premise that senior decision-makers at broadcasting companies are knowledgeable about their audiences, and can be actively implicated in the production culture of both of their companies and society in general. These professionals are therefore the drivers and implementers of expectations regarding successful and desirable media practices (Draper, 2014; Ross, 2014). Consequently, it should come as no surprise that in a society where science is not part of public discourse and in which scientific content does not feature prominently in its media culture, that the people who run television networks do not have very clear ideas about the topic. As attitudes are predictors of behavior and intentions (Ajzen, 1985; Ajzen & Fishbein, 1980), it would seem obvious that Spanish TV managers do not include scientific content among their priorities. Therefore, and consistent with Soto-Sanfiel & Latorre (2014), not only does the media need to include more scientific content in their television schedule, science needs to also be taught at the earliest stages of the education cycle in order to foster an advanced society that is more open to learning and consuming scientific content.

It would not be fair to attribute all the responsibility for the lack of scientific content on the Spanish media to its professionals. However, they must be also considered a relevant variable since they participate in the decision-making or creative production of the televisual scene. Given the business-focused and commercial logic of modern-day television, actions to raise awareness to promote and increase the exposure to science, and of scientific content in the media, are the responsibility of public agencies and organizations as the professionals themselves believe. Indeed, future research should study the degree of responsibility assumed regarding the presence of science in society, not only by the managers of Spanish media corporations (and especially public ones) but also by the employees of institutions that are directly responsible for ensuring the public promotion of science education in Spain.

Finally, this research could be replicated in other countries to observe the degree of generality, within the members of the international audiovisual industry, of its conclusions.

6. References

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Annex 1

Table A1 Characteristics of Profiles

| | General (N = 450) | Negative opinion (n = 34) | Neutral opinion (n = 296) | Positive opinion (n = 126) | Contrast Statistic(df) |
|--|------------------------------|--|--------------------------------------|---------------------------------------|-----------------------------------|
| Sex (%) ¹ | | | | | 1.1(2) |
| Woman | 46.67 | 41.18 | 45.95 | 50.00 | |
| Man | 50.44 | 55.88 | 51.35 | 46.67 | |
| Unknown | 2.89 | 2.94 | 2.70 | 3.33 | |
| Education (%) ¹ | | | | | 11.0(8) |
| Primary studies | 4.00 | 5.88 | 4.73 | 1.67 | |
| Secondary studies | 14.44 | 14.71 | 11.49 | 21.67 | |
| Professional training | 56.00 | 50.00 | 58.78 | 50.83 | |
| University studies | 19.56 | 26.47 | 18.92 | 19.17 | |
| Doctoral studies | 5.56 | 2.94 | 5.74 | 5.83 | |
| Unknown | 0.44 | 0.00 | 0.34 | 0.83 | |
| Age (<i>M</i> [<i>SD</i>]) ² | 45.5[9.9] | 43.4[11.1] | 45.7[9.8] | 45.6[9.8] | 0.78 (2, 444) |
| Years of Experience (<i>M</i> [<i>SD</i>]) ² | 20.3[9.7] | 19.8[10.5] | 20.4[9.6] | 20.1[9.7] | 0.07 (2, 432) |
| Type of firm (%) ¹ | | | | | |
| TV Channel | 85.11 | 82.35 | 84.46 | 87.50 | |
| Producer | 7.11 | 5.88 | 9.46 | 1.67 | |
| Both | 7.33 | 8.82 | 5.74 | 10.83 | |
| Unknown | 0.44 | 2.94 | 0.34 | 0.00 | |
| Type of TV (%) ¹ | | | | | |
| National | 36.67 | 70.59 | 32.09 | 38.33 | |
| Autonomic | 55.78 | 20.59 | 59.12 | 57.50 | |
| Local | 2.44 | 2.94 | 2.03 | 3.33 | |
| Unknown | 5.11 | 0.00 | 0.00 | 0.00 | |
| Ownership (%) ¹ | | | | | |
| Public | 86.44 | 58.82 | 86.15 | 95.00 | |
| Private | 9.11 | 32.35 | 8.45 | 4.17 | |
| All | 4.22 | 8.82 | 5.07 | 0.83 | |
| Unknown | 0.22 | 0.00 | 0.34 | 0.00 | |
| Area (%) ¹ | | | | | 5.2(2) |
| Production-creation | 71.11 | 64.71 | 67.91 | 80.83 | |
| Managerial-organizational | 24.44 | 23.53 | 27.36 | 17.50 | |
| Unknown | 4.44 | 11.76 | 4.73 | 1.67 | |
| Related to production ¹ (%) | | | | | 5.5(1) |
| Yes | 35.33 | 47.06 | 31.76 | 40.83 | |
| No | 64.00 | 50.00 | 67.57 | 59.17 | |
| Unknown | 2.94 | 2.94 | 0.68 | 0.00 | |

¹ Chi-square test; ² ANOVA test

Figure A1. Standardized Scores by Profile Group

