Bridging the gap between experts and publics: the role of multimodality in disseminating research in online videos

María-José Luzón
Universidad de Zaragoza
mjluzon@unizar.es

Abstract

The Internet provides researchers with tools to disseminate their research findings to different audiences and meet the information needs of various publics. One of these tools is online science videos, which can be addressed to audiences with different degrees of expertise and shared on various platforms. The current study analyzes a set of online videos used by research groups to inform about their research and findings and engage the audience with this research. My purpose is to analyze how multimodal strategies are used in these videos to recontextualize knowledge for a wide audience. The analysis reveals four types of strategies, which may be performed through the orchestration of various semiotic modes: (i) strategies to construct the research group's credibility and authority; (ii) strategies to construct persuasive arguments; (iii) strategies to tailor information to the assumed knowledge of potential viewers; (iv) strategies to bond with the viewers and engage them.

Keywords: digital genres, online videos, multimodality, science dissemination, recontextualization

Resumen

Tendiendo puentes entre expertos y públicos: el papel de la multimodalidad en la diseminación de la investigación en vídeos online

Internet ofrece a los investigadores diversas herramientas para difundir los resultados de su investigación y satisfacer las necesidades de información de públicos diversos. Una de estas herramientas es el vídeo científico en línea, dirigido a públicos más o menos expertos en la disciplina, y que puede compartirse a través de varias plataformas. El presente estudio analiza una serie

de vídeos utilizados por diferentes grupos de investigación para informar sobre su trabajo y resultados. Mi objetivo es analizar cómo se utilizan las estrategias multimodales en estos vídeos para recontextualizar el conocimiento cuando se dirige a un público más amplio. El análisis revela la existencia de cuatro tipos de estrategias, que pueden llevarse a cabo por medio de la coordinación de varios modos semióticos: (i) estrategias para construir la credibilidad y autoridad del grupo de investigación; (ii) estrategias para construir argumentos persuasivos; (iii) estrategias para adaptar la información al conocimiento de los espectadores potenciales, y (iv) estrategias para crear vínculos con los espectadores e implicarlos en la investigación.

Palabras clave: géneros digitales, vídeos en línea, multimodalidad, divulgación científica, recontextualización

1. Introduction

The online environment, with its multimodal affordances, offers researchers new possibilities for dissemination of their research and for public outreach. Online videos have become a popular tool to communicate science to the public (Kousha, Thelwall & Abdoli, 2012; Erviti & Stengler, 2016; León & Bourk, 2018) and are used by academics, universities and other organizations to disseminate courses and other educational content (Pasquali, 2007; Kousha, Thelwall & Abdoli, 2012). Given the potential of online videos for the communication of science, researchers are analyzing them from different perspectives, e.g. the uses of online videos for education (DeCesare, 2014), the different types and purposes of online science videos (Thelwall, Kousha, Weller & Puschmann, 2012; Muñoz-Morcillo, Czurda & Trotha, 2016), or the factors that affect their popularity (Thelwall et al., 2012; Welbourne & Grant, 2016; Erviti & León, 2016). However, except for studies on a specific type of online video genre, TED Talks (e.g. Scotto di Carlo, 2014; Santini, 2015), there has been little research on how online videos are exploited by academics to disseminate information about science to the public and to promote their work and findings. Additionally, studies on TED Talks have foregrounded the oral mode of communication and have concentrated almost exclusively on the analysis of linguistic features. However, the multiplicity of semiotic resources deployed in online science videos calls for the need to study how various modes interact to make meaning and achieve the communicative purpose of the genre. The main focus of this paper is the interplay of various modes in online science videos to recontextualize knowledge for the intended audience.

The possibilities for public dissemination afforded by online videos are particularly important in the current research context, where funding agencies are increasingly encouraging researchers' involvement in outreach activities and interaction with the lay public. The current study analyzes online videos used by research groups to inform both peers and the interested public about their research, in order to update scientifically informed users and engage peers and the public with this research. These videos share features with science documentaries, in that they combine narration and audiovisual modes for both informative and persuasive purposes: they are intended not only to inform the audience but also to persuade them of the relevance of the research. The purpose of the study is to analyze how multimodal strategies are used to achieve specific rhetorical purposes and to meet the information needs of the audience. I attempt to answer the following questions: (i) How is the credibility and authority of the research group constructed? (ii) How do different modes interplay in the construction of arguments? (iii) How do different modes contribute to making the content understandable? (iv) What rhetorical strategies are used to engage the viewer and how are they realized?

2. Online videos and audiences in academic communication

There is a wide variety of online science videos (Kousha et al., 2012; León & Bourk, 2018), differing in terms of purpose and intended audience. In their study, Thelwall et al. (2012) classified online science videos into six categories: scientific demonstration, public dissemination, education, talks to academics, information about scientists, and comedy. These purposes and the way the videos are produced are clearly related to the audience. Some online videos are used as tools to communicate with peers, to show experimental details or illustrate methods (Thelwall et al., 2012). *The Journal of Visualized Experiments* (JoVE, http://www.jove.com/), for instance, is a peer reviewed scientific video journal which publishes research in a visual format. Some journals provide short video summaries of their published papers, either embedded on the journal website as a complement to the paper or on their YouTube channel, e.g. the journal *Clinical Gastroenterology and Hepatology*, the *New Journal of Physics* or the *Journal of Number Theory*. These videos help to provide information that is difficult to convey only with text, such as the morphological change of cells (Pasquali, 2007).

Online video is also used as a tool to communicate with and engage the lay public (Jenkins, 2007; Thelwall et al., 2012; Scotto di Carlo, 2014). Its multimodal nature makes it a very effective and accessible format to communicate complex scientific ideas, explain scientific concepts and communicate science to the interested public (Pasquali, 2007; Thelwall et al., 2012). Publications like *Nature* or *New Scientist* use videos as a complement to their publication to tell people about the research they publish in a visual way. In the words of Sandrine Ceurstemont (multimedia producer at *New Scientist*), "in certain cases, video is the most attractive way to convey certain stories, because you can describe some things in words, but you just see the video and, right away, you get the point" (Erviti & Stengler, 2016: 7). The web helps researchers publishing in *Nature* to reach a wide diversified audience, consisting both of other researchers and the interested public. The fact that online videos can be embedded in several websites and shared on social media contributes to this widening of their audience.

Some research groups are also harnessing the affordances of the online video to promote their work among different audiences. The audiovisual presentations embedded on their websites or available on online platforms (e.g. *YouTube, Vimeo*) are more engaging both for peers and for the lay public than the written description of their research available on their websites. Through these videos, groups can interact directly not only with peers but also with a wider audience, and arouse public interest in their research activity and their discipline.

3. Multimodality and recontextualization

Online science videos are multimodal texts which draw on several modes or semiotic resources (e.g. non-verbal sound, spoken and written language, image) to re-contextualize scientific discourse. Therefore, the analysis of communication, representation and re-contextualization in these texts should be approached from a multimodal perspective.

3.1. Multimodality

MDA (Multimodal Discourse Analysis) is based on several assumptions (Kress & van Leeuwen, 2001; Kress, 2003; Bezemer & Kress, 2008; Jewitt, 2009): language is just one part of an ensemble of modes, all of which contribute to meaning; modes have differing modal resources (e.g. writing and speech share

lexical and grammatical resources, but they also have other resources, like punctuation in the case of writing, and pitch in the case of speech; images use resources like size and color, and, in the case of moving images, movement) and therefore they can be used to realize different meanings, i.e. they have different affordances; meaning is constructed through the selection, combination and interaction of modes, that is, modes work together to create what Kress and Van Leeuwen (2001) call "communicational ensembles". The affordances of the different modes for meaning-making enable "sign makers to do different work in relation to their interests and their rhetorical intentions for designs of meaning, which, in modal ensembles, best meet the rhetor's interest and sense of the needs of the audience" (Bezemer & Kress, 2008: 171).

Analyzing academic genres from this perspective involves regarding genres as "discernible patterns of semiosis" (O'Halloran, 2009: 99) and accepting that the social purpose of the genres is achieved not only through language but through the interaction of several semiotic modes. Genres differ in their semiotic affordances for creating various types of meaning (Kress & van Leeuwen, 2001; Bateman, Delin & Henschel, 2007; Bateman, 2008). Users select semiotic resources from these afforded by the genre and combine them in such a way that they work together to achieve the communicative purpose of the genre. According to Bateman (2008), multimedia genres are constituted by collections of rhetorical strategies which collaborate to achieve the goal of the genre through the deployment and selection of the semiotic modes made available by the medium.

3.2. Recontextualization

This study explores communication and representation in interview-based science documentaries, i.e. documentaries where the researchers themselves tell the story of their research. In these texts the scientific discourse of formal academic genres is recontextualized in online science videos, harnessing the multimodal affordances of digital video. Bezemer and Kress (2008: 184) define recontextualization as follows:

> moving meaning material from one context with its social organization of participants and its modal ensembles to another, with its different social organization and modal ensembles. Meaning material always has a semiotic realization, so recontextualization involves the re-presentation of the meaning materials in a manner apt for the new context in the light of the available modal resources.

This definition is particularly relevant in the context of this study because it is based on the assumption that meaning is made through the interaction of modes.

Recontextualization is achieved through various rhetorical processes, e.g. "simplification" or "condensation"; "explicitation", "reformulation" and "elaboration"; and "refocusing" (Calsamiglia & van Dijk, 2004; Bezemer & Kress, 2008; Bondi, Cacchiani & Mazzi, 2015). According to Bezemer and Kress (2008), recontextualization involves four rhetorical principles: "selection" (of meaning material that is relevant in the new context and contributes to the rhetor's interest, and of modal resources which are available in the new context and are appropriate for the audience of this context); "arrangement" (of the meaning materials in a way that is best for the audience and for the rhetor's purpose); "foregrounding" (of the elements that are particularly significant in the new context); and "social reposition" (or reconstruction of social relations between the rhetor and the audience of the new context).

As a result of the current interest in the public understanding of science, there is a growing body of research on the strategies used in different genres to transform scientific discourse into discourse that meets the interests of the lay or interested public (e.g. Hyland, 2010; Luzón, 2013; Scotto di Carlo, 2014; Hunston, 2015). Hyland's (2010) concept of "proximity" helps us to understand the different facets of recontextualization in popular texts. "Proximity" refers to:

> a writer's control of rhetorical features which display both authority as an expert and a personal position towards issues in an unfolding text. It involves responding to the context of the text (…) It is concerned with how writers represent not only themselves and their readers, but also their material, in ways which are most likely to meet their readers' expectations (Hyland, 2010: 117).

Hyland compares how proximity is constructed in texts intended for experts and for a lay public and in doing so he shows how the discourse of research articles is recontextualized in popular science. For instance, in popular science new concepts are defined and explained, in order to adapt information to the assumed knowledge of the potential readers, and questions and second person pronouns are used to involve the reader. Hunston (2015) analyzed interviews with scientists on a radio programme and found that they used interpersonal strategies to promote their work in

front of the general public, e.g. evidentials and status markers, emphasis on the novelty of results or value of the research. Recontextualization strategies have also been explored in digital genres (e.g. Luzón, 2013; Scotto di Carlo, 2014). In science blogs, the bloggers' desire to reach a wide and diversified audience leads to the use of strategies to connect with the interested public (e.g. informal discourse, personal narratives) and to the blending of discursive practices from different discourses (Luzón, 2013). In TED Talks speakers draw on various discourse strategies to establish a close relation with the audience and enhance their credibility (Scotto di Carlo, 2014).

4. Corpus and Method

4.1. Corpus

The corpus analyzed in this study is composed of 14 online videos where research groups report on their research. Two sets of videos have been selected: (i) promotional videos produced by research groups themselves or their institutions, available on the research group's website or on other platforms like *YouTube* or *Vimeo* (or on both), where the groups tell about their research lines (henceforth referred to as "Presentation Videos"); (ii) videos from *Nature* Online Video Streaming Archive, also available on the *Nature YouTube* channel, which act as complements to published papers (henceforth referred to as "Nature Videos"). Charlotte Stoddart, the Head of Multimedia at *Nature*, stated that the video format enabled both scientists and public to understand better the published research (Erviti & Stengler, 2016). The objective of both types of videos is the promotion of scientific culture and the dissemination of the group's research activity. However, while Nature Videos recontextualize the specific research reported in the paper, Presentation Videos report more broadly on the group's areas of research and interests. Therefore, they may resort to different rhetorical strategies and resources to achieve their communicative purpose.

Seven videos were selected from each group (see Appendix). In order to find the Presentation Videos, search words like "(our) research group", "(our) research team" were used in *Google Videos, YouTube* and *Vimeo*. The following criteria were used to select these videos: (i) they should be in English; (ii) they should be interview-based science documentaries; (iii) they should be between 3 and 6 minutes long; (iv) they should have been produced in the last 3 years or (if they were older) they should still be present on the research

group's website (to make sure that they were still relevant for the group). Regarding the Nature Videos, all of them are written in English. I selected the seven most recent interview-based science documentaries (at the time of collection) with a length between 3 and 6 minutes.

The corpus size is moderate for two reasons. First, it was difficult to find Presentation Videos that met all the selection criteria listed above: many research groups produce Presentation Videos in their own first language, rather than in English, to reach a local audience; in addition, in some cases groups do not use interview-based science documentaries to present their research, but a monologic format. The second reason to select only 14 videos was the need to work with a manageable corpus, since the analysis involved looking at a variety of semiotic resources. A corpus of this size provides enough analytic data for the type of study (i.e. mostly qualitative) reported in this paper, and is in line with the corpora used in other studies of multimodality in academic genres (Querol-Julián & Fortanet Gómez, 2012; Valeiras-Jurado, Ruiz-Madrid & Jacobs, 2018).

4.2. Method

In this research a multimodal perspective is adopted to analyze the recontextualization of academic discourse in online science videos. From this perspective, the focus of analysis is on how the different semiotic resources which are co-present in the videos interplay to enact rhetorical strategies.

Paltridge (2012) notes that when carrying out MDA there are often too many data for analysis and therefore it is necessary to select specific aspects to examine. Due to the impossibility of analyzing all the semiotic resources that contribute to the recontextualization of science in online videos, I decided to focus on the following modes: speech, written language, static images, and moving images. Paralanguage and kinesic features are not analyzed, despite their importance in genres where scientists present research orally (see Querol-Julián & Fortanet Gómez, 2012; Ruiz-Madrid & Fortanet Gómez, 2017). I will discuss briefly the role of gestures when they play a particularly important role, but the detailed study of gestures by participants in the video is too complex to be dealt with in this study.

The data for this study were analyzed with Atlas.ti, a qualitative data analysis tool which allows annotation and coding of text, audio and video documents. Documents can be loaded on Atlas.ti to make a corpus, and

selected data segments in these documents (video segments in the current study) can be assigned one or more codes. In this study, coding was done by starting with an initial list of anticipated codes which evolved over time, as some codes were eliminated and new codes emerging from the data were added.

To design this initial code list, I took into account research on the discursive strategies used in scientific discourse to respond to the context of the text (Fahnestock, 1986; Calsamiglia & Van Dijk, 2004; Giannoni, 2008; Hyland, 2010; Luzón, 2013). These studies provided the justification for the classification of recontextualizing strategies into four groups: (i) strategies to construct the research group's credibility and authority ("Source credibility"); (ii) strategies to construct persuasive arguments ("Convincing arguments"); (iii) strategies to tailor information to the assumed knowledge of potential readers ("Framing"); (iv) strategies to engage the viewers ("Engagement"). Previous research on rhetorical strategies also provided information on the semiotic resources to realize these strategies, which guided their identification in the corpus. For instance, "Appeal to novelty" can be realized verbally through positive evaluation (e.g. "a new approach"). The initial code list based on previous research was complemented with codes generated on the basis of my observation of the data, using the "coding in vivo" option of Atlas.ti. The rationale for this methodological decision was that previous research focuses mainly on verbal modes, and, since visual modes have such an important role in meaning-making in science videos, it is necessary to consider also visual semiotic resources and analyze how they are co-deployed with other semiotic resources to enact rhetorical strategies.

The first phase in the analysis of the video corpus consisted in viewing each of the videos twice to get a general impression of the rhetorical work and of the strategies used in these videos to recontextualize scientific knowledge. The second phase consisted in coding the data. In the first round, video segments were assigned descriptive codes (semiotic resources related to each of the four broad categories of strategies: "Source credibility", "Convincing arguments", "Framing" and "Engagement"), e.g. "Video footage representing researchers doing science. Source credibility". "Verbal non-technical explanation. Framing". These codes were then grouped into categories (strategies). For instance, "Video footage representing researchers doing science" was grouped into the category "Representing researchers as experts". Coding was an iterative process, which involved refining codes, eliminating redundant ones or merging those that were minimally different.

The possibility of assigning more than one code to each data segment helps to reveal how various semiotic resources are co-deployed to enact rhetorical strategies.

Tables 1-4 in section 5 list the different strategies and semiotic resources that were coded for. As pointed out above, this is a qualitative study, intended to show how various modes interplay to realize strategies through which research is contextualized in online videos. However, some quantitative information is provided (i.e. the number of videos in each set where the various semiotic resources are used) to help establish the relation between the use of these resources and the communicative purpose of the genre.

5. Results

In this section I discuss how various semiotic resources are co-deployed in science videos to establish the group's authority and credibility, shape the material to construct persuasive arguments, tailor information to the audience's needs, and engage and position the audience.

5.1. Establishing the group's authority and credibility

Table 1 presents the different strategies to establish the group's authority (in italics) and the resources through which these strategies are realized. The table also provides quantitative information on the number of videos where these strategies and resources occur, to determine the extent to which they are typical of this type of video. Quantitative data are provided on the two sets of videos separately to reveal any possible difference.

In order to bestow credibility on the researchers reporting the information, three strategies are used: informing of the researcher's/ group's position and affiliation, representing researchers as experts, and informing about the group's collaborators. Viewers are informed of the group's affiliation through several modes: by means of superimposed writing when the researchers first appear on screen; through speech, with the researchers introducing themselves (e.g. 1a) or with voice-over presenting the group (e.g. 1b); by means of images (e.g. Faculty, logo). Setting contributes to constructing the academic identity: all videos but one are filmed in an academic setting (laboratories, facilities of the research center, offices) and in the case of Presentation Videos a picture of the main entrance of the

Strategies and semiotic resources	No. of videos (Nature)	No. of videos (Presentation)
Informing of researcher's/ group's position and affiliation		
Voice-over information about researcher's/ group's affiliation	1	2
Researcher's self-introduction	1	2
Written identification of researcher's/ group's affiliation	7	7
Image of Faculty, University, Research Centre	0	7
University logo	0	2
Visual representation of academic setting	6	7
Representing researchers as experts		
Researchers presenting their own research verbally	7	7
Video footage representing researchers "doing science"	7	7
Video footage representing researchers explaining aspects of their research	7	2
Visual representation of equipment	7	7
Exclusive "we"	7	7
Positive verbal evaluation of the group and their facilities	0	2
Informing about the group's network		
Reference to collaborators	0	6

Table 1. Semiotic resources to establish the group's authority and credibility.

Faculty building or the Research Centre is always present. All these resources contribute to the meaning that the researchers' authority is institutionally legitimate.

1a.   My name is Guido Schäfer. I'm the group leader of the Networks and Optimization Group here at CW (V11)

1b.   The heterogeneous catalysis and sustainable chemistry group led by professor Gaddy Rothenberg forms part of the Vanette HOF Institute for molecular sciences at the university of Amsterdam (V12).

The representation of researchers as experts is also achieved by the interplay of visual and verbal resources. In all the videos researchers themselves present their research (even if in some videos there is also a voice-over or external narrator): in Nature Videos researchers present a specific finding and in Presentation Videos they present their research line or main achievement. In all the videos, live-action footage represents members of the group "doing research" in their research setting and using the methods of their discipline, e.g. digging in archaeological sites, using laboratory equipment or computers. Additionally, in 64.3% of the videos (100% of the

Nature Videos) researchers are represented explaining aspects of their research: they describe the procedures and methods they use, or they explain concepts and theories. These visual and verbal resources are combined to show researchers' expertise and knowledge of the discipline and their mastery of disciplinary procedures and practices.

The use of "exclusive we" also helps to enhance authority and give visibility to the group. This linguistic device is, however, used differently in the two sets of videos. In Nature Videos "exclusive we" performs mostly the discourse function of "recounter of the research process": a writer "who describes or recounts the various steps of the research process" (Tang & John, 1999: S28) (see example 2). This recount shows that researchers are familiar with disciplinary procedures and methods and thus helps to construct their identity as experts.

> 2. We selected two pairs of animals (…) We measured the muscle power (…) So to measure these things, we used wildlife tracking collars (V2)

In Presentation Videos "exclusive we" performs mainly the discourse function of "originator", a role in which speakers "claim authority" and ownership of findings and show "that they perceive themselves as people who have the right and the ability to originate new ideas" (Tang & John, 1999: S29) (see examples 3a and 3b).

> 3a. In our group we develop mathematical tools to solve complex optimization problems coming from real world applications (V11)

> 3b. Several or our discoveries have resulted in valuable inventions (…) Most recently, we've discovered a new type of biodegradable plastic. It is completely biodegradable, made of 100% plant-based materials (V12)

Authority is also constructed by the positive evaluation of the group, their research outcomes or their equipment (as evidence of their capability to conduct research). For example, in V14 the researcher states "we have become a world recognized research team internationally". Similarly, in V12 the voice-over describes the group as "internationally known as a leader in catalyst discovery and optimization" and the members of the group use the following words to describe their lab: "newest commercially available equipment",

"brand new lab", "state of the art equipment". The frequent pairing or "we"/"our" with positive evaluation foregrounds the relevance, novelty and importance of the groups' research (see examples 3a and 3b above).

Finally, in Presentation Videos, making reference to collaborators and stressing the importance of the collaboration also helps to reinforce the credibility of the researchers.

5.2. Shaping material to construct persuasive arguments

Table 2 presents the different strategies and semiotic resources used in these videos to make arguments and claims more acceptable for the viewers.

Strategies and semiotic resources	No. of videos (Nature)	No. of videos (Presentation)
Presenting a narrative of nature		
Chronological verbal presentation	6	0
Visuals to support the narrative	6	0
Appeal to novelty or newsworthiness		
Evaluative language to express a gap/ problem/ challenge	4	5
Positive verbal evaluation of their research	4	5
Appeal to application		
Linguistic expression of ability	4	7
Listing of uses or applications	3	3
Visual representation of uses or applications	3	3
Providing supporting evidence for claims		
Visual providing evidence for what is being said	5	1
Providing evidence with gesture/ action	1	0

Table 2. Semiotic resources to make claims and arguments convincing.

Although in both sets of videos several semiotic resources are combined to construct persuasive arguments, there are some differences in the resources used for this purpose. Nature Videos are similar to popularizations in that they present a "narrative of nature" (Myers, 1990): the narrative is organized chronologically and focuses on the object of research, rather than on the research process. This chronological presentation helps to "enhance the visibility of information and make the message more convincing" (Hyland, 2010: 121). In the videos the verbal chronological narration is integrated with images which help viewers visualize the stages of the narrative and attract their attention to the object of research. Presentation Videos do not present a narrative of nature, probably due to the fact that these videos are intended to present an overview of the group's research activity rather than report on a specific finding.

Another difference between the two sets of videos is the use of visuals to construct arguments. There are more Nature Videos where visuals help to provide evidence for claims. This is consistent with the fact that these videos recontextualize *Nature* papers where a claim to knowledge is made. As can be seen in example (4), different types of visuals can be used for support, e.g. video footage, computer simulation, still images, or various disciplinary visual aids. In V2 video footage illustrates what the researcher says: a cheetah is filmed chasing its prey and trying to catch it up (e.g. 4a); in V1 the researcher shows that a helmet fits on her head by actually trying it on (e.g. 4b); in the same video the researcher explains how MEG (Magnetoencephalography) works and uses the scan image on the computer to actually show areas of the brain moving, and thus provide evidence for what he says (e.g. 4c).

4a. The prey is … always a stride ahead and the predator is always playing catch-up *(+video footage)* (V2)

4b. It fits perfectly on my head *(+video footage)* (V1)

4c. We can localize which area of the brain is responsible for the movement *(+scan image)* (V1)

To make the research valuable for the audience, these videos draw on the "novelty" appeal, i.e. presenting the research as a new contribution to existing disciplinary knowledge (Hyland, 2010) and the "applications" appeal, i.e. presenting the research as having further benefits or future applications (Fahnestock, 1986). Hyland (2010) notes that novelty is negotiated differently in research papers and popular texts. While in research papers claims for novelty are made against existing disciplinary knowledge, in popular texts the novel is changed into the newsworthy and scientific findings are evaluated in terms of uniqueness and immediate value for the audience. The evaluative statements in examples (5a) and (5b) are used to emphasize that the group is making a contribution to existing knowledge:

5a. What makes the group <u>special</u> is that it connects deep methods from mathematics to practical problems from logistics (V11)

5b. We are taking all that software and all that knowledge....and bringing it into <u>new</u> domains of biology and nanotechnology (V9)

Example (6) illustrates the newsworthiness appeal. The first sequences of the video intersperse the expressions of "wonder" by an expert outside the

research group and by a group member with written text on a black screen. Both in the participants' speech and in the written text, uniqueness and originality is stressed with the use of evaluative vocabulary. This is combined with emphasis of this evaluation achieved through intonation (high pitch words appear in CAPITALS) and gestures.

6.   Expert's speech: My first reaction on reading the paper was NO this is wrong, something is wrong.

Written text: An archaeological dig in California…

Researcher's speech: They are gonna think, this is crazy, this is outrageous

Written text: …has unearthed something almost unbelievable…

Expert: I didn't believe it. I STILL don't believe it properly.

Written text: ..about the first human to reach North America

Researcher's speech: It really is a paradigm shift in terms of when humans arrived in this continent.

Expert's speech: and if it DOES turn out to be true, it changes ABSOLUTELY everything

Videos in both sets establish the relevance of the research by presenting the research process as a result of the researchers' effort to solve a problem or challenge (see examples 7a and 7b). The claim for novelty or newsworthiness is usually based on the positive evaluation of the solution to that problem (see examples 7c and 7d). Although the presentation of the problem is mostly done verbally, through the use of evaluative vocabulary, visuals can help to provide evidence for the negative evaluation, as shown in example (7b). The utterance of "very large, they are very bulky and that one size fits all" is synchronous first with the researcher's gestures and then with the image of an EMG scanner through which the audience can actually see how bulky these devices are.

7a.   One of the real <u>challenges</u> for sport teams is to decide when their athletes will be ready to return to sport. The work we do here at LGMU <u>allows us to help inform</u> those decision-making processes (V8)

7b.   The <u>problem</u> with current EMG scanners is that they are <u>very large, they are very bulky and that one size fits all</u> (V1)

7c. The existing commercial processes for making nylon are not very clean. They use corrosive chemicals and produce large amount of byproducts. We are now developing a <u>new</u> process that <u>avoids these problems</u> (V12)

7d. One of its work areas is the design of <u>revolutionary</u> biosensors with <u>highly competitive</u> properties …(V10)

The "applications" appeal is realized through semiotic resources that stress and present the usefulness or benefits of the research (both verbally and visually): linguistic expressions of ability help to present the benefits that the research will bring to the audience (see example 8a); verbal presentation of uses or applications are synchronized with video footage representing these applications, which helps the viewers visualize and remember them (see example 8b)

8a. With this new technology scanning babies… is going to become possible (…) I think <u>we will certainly be able to</u> really start seeing the neural substrate that underlie these disorders in children (V1)

8b. These kind of three-dimensional visualizations may instead be used to train medical professionals for advanced procedures. They can also be used in aviation. (+ *visuals showing applications*) (V5)

5.3. Strategies to tailor information to the needs of the interested public

In the videos analyzed visual and verbal semiotic resources interplay to make the message more understandable for the lay audience. As in popular texts, in online science videos language is used to explain or clarify concepts or processes that may be unfamiliar for viewers. Concepts, theories or processes are defined or explained in non-technical language or compared to other everyday concepts or processes that lay people can engage with (see example 9). These linguistic resources are most often co-deployed with visuals for a clearer explanation of how science works. Visual resources interact with verbal resources in a variety of ways: definitions, comparisons and descriptions may be accompanied by images, as is the case of the definition in example 9; an object may be mentioned synchronously with its verbal representation, which makes further verbal explanation unnecessary (see example 10); deixis is accompanied by visual representation of the

Strategies and semiotic resources	No. of videos (Nature)	No. of videos (Presentation)
Comparison	3	0
Definition	3	3
Representation/ description of an object		
Verbal description of an object	4	0
Visual representation of an object mentioned in the video (naming+ deixis)	7	4
Non-technical explanation of disciplinary procedures and methods		
Verbal non-technical explanation	5	1
Representation of disciplinary procedures through video footage	3	2
Non-technical explanation or demonstration of concepts, theories		
Verbal non-technical explanation or demonstration of concepts, theories	6	5
Symbolic images to facilitate understanding of researcher's explanation	6	4
Visual elaboration of what the researcher is saying	2	0
Emphasis, noticing		
Written language of key words	4	1
Gestures	7	7

Table 3. Strategies to tailor information to the needs of the interested public.

object (see example 11); moving simulations show what the researcher is explaining or what the voice-over is saying. For instance, in V3 the researcher explains the different injuries in a skull and the video shows a simulated skull spinning to show the injuries that the speaker is talking about.

9. A volumetric image is essentially an image that is taking up three-dimensional space *(+ filmed image of a volumetric image)* (V5)

10. If you produce a <u>trabecular lattice</u>, you could grow cells.*(+ filmed image of a trabecular lattice)* (V9)

Figure 1. Researcher holding a trabecular lattice

11. This is a cheetah collar, this is a zebra collar and this is a lion collar (+ *filmed image of the researcher pointing to the different collars*) (V2)

The explanations of disciplinary procedures and methods are also illustrated visually: information is presented synchronously in two modes (moving image and speech) to help understanding. For instance, in V7, the narrator's and the researcher's voices are interspersed to explain how the research group makes a new kind of maser using diamond, while one of the researchers demonstrates the whole process, in such a way that the viewers have a visual representation of the process and can actually see all the stages (e.g. "And then what we do, we actually shine a green laser. And when the laser hits the NV centers, the diamond glows a rich pink"). Similarly, in V8 the principal investigator explains one of the techniques used by the group, i.e. three-dimensional motion analysis, while a participant in the video illustrates this technique (see Figure 2).

Figure 2. Illustration of three-dimensional motion analysis.

Another frequent strategy to help the viewers understand how science works and clarify scientific content is having the researcher explain or demonstrate the concepts with the help of visual aids: explanations are combined with writing or drawing on a whiteboard or on paper, with images and simulations on computers, or with simulations superimposed on the video footage. In V7, for example, the researcher uses the whiteboard to explain how masers work and in V8 (see Figure 3) a computer simulation helps to explain how three-dimensional motion analysis works.
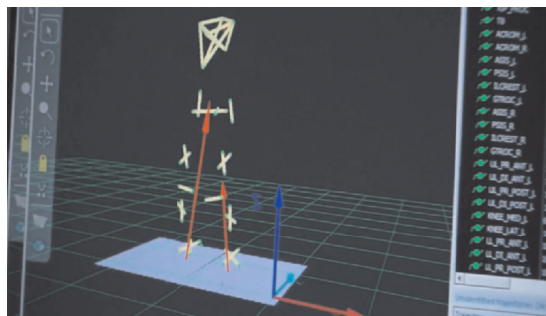
Figure 3. Computer simulation of three-dimensional motion analysis.

Visuals can also be used to elaborate content that has been presented in speech, although this is not frequent, since visuals usually co-occur with explicit verbal explanations. For instance, in V3 the utterance in example (12) is synchronous with a drawing which provides more detailed and specific information of "peculiar position". The researcher does not need to describe that "peculiar position" verbally because it is very clear from the image.

12. A young lady who was found sitting and she had her hands crossed in a very peculiar position (V3)

Finally, another strategy that helps comprehension by enhancing information is emphasis, defined by Valeiras-Jurado et al. (2018: 110) as "highlighting parts of the message so that they receive more attention". In the videos in the corpus emphasis is mainly achieved through intonation, gestures and written text. Written language helps to emphasize and draw attention to elements of spoken discourse (e.g. technical concepts). For instance, in V7 the participant is using the whiteboard to explain how masers work and when he says "This putting electrons into a higher stage is called a population inversion", "population inversion" is written on the blackboard and underlined. In the same video, the researcher describes a maser assembly, with the help of video footage, and the different elements of the assembly are labeled with written text superimposed on the image of the assembly.

5.4. Strategies to engage the audience

Hyland (2010: 295) defines engagement as "an alignment dimension of interaction where writers acknowledge and connect to others". The semiotic

devices that interplay in the videos analyzed to engage the audience are presented in Table 4.

Strategies and semiotic resources	No. of videos (Nature)	No. of videos (Presentation)
Creating intimacy and dialogic involvement		
Inclusive we	5	1
Reference to viewers	4	2
Questions	3	1
Personal narratives	6	0
Informal language	4	0
Representation of researchers in everyday situations, actions	2	1
Attracting or focusing the audience's attention, raising interest		
Images representing content mentioned in speech	6	1
Questions	3	1
Statement of a problem or challenge to solve	4	5
Expressing feelings or emotional reactions		
Verbal expressions of feelings or emotional reactions	4	2
Non-linguistic expressions of feelings or emotional reactions	5	0

Table 4. Semiotic resources to engage the audience.

As table 4 shows, resources to engage the audience are more varied and more frequently deployed in Nature Videos. A variety of semiotic resources help to establish affinity and solidarity, and to recognize the presence of the viewers and connect with them.

Pronouns play an important role in establishing affinity and intimacy. Most Nature Videos use inclusive "we" or "our" to construct a bond with the audience (see example 13). As in TED Talks (Scotto di Carlo, 2014), "inclusive we" helps to involve the audience by transmitting the message that researchers and audience are alike and share common interests. These inclusive uses help to represent the viewers as participants in scientific research.

13. Nanotechnology is placing tools within our grasp that will revolutionize the way in which we carry out diagnosis and treat diseases, the way we manage the environment and the food industry (V10)

Viewer pronouns are also present in more than half of Nature Videos (e.g. 14a and 14b). They help researchers to attract the viewer's attention; to involve the viewers in the construction of the argument, by anticipating their opinion and accepting or rejecting it to present their own claim (e.g. 14a); or to engage in a dialogic interaction with the viewers (e.g. 14b). In example

(14b) the question is directly addressed to the viewer and both linguistic elements (the pronoun you, and the question) contribute to initiating an imaginary dialogue. Questions help to create an intimate relation by helping to present videos as conversations with the audience.

> 14a. So, you might think the prey's strategy should be to run as quickly as possible away from the predator. That is absolutely not the case. Because the predator is faster and is catching the prey up (*longer explanation*) (V2)

> 14b. For example, imagine you're a transportation company and have to route your trucks through the network in order to satisfy several pick-up and delivery requests of your customers. How can you determine an optimal routing scheme, satisfying all these requests in the cheapest possible way? (V11)

Representation of researchers in everyday situations (e.g. drinking coffee, chatting with colleagues), informal language (e.g. "So, yeah", "I mean", "you know", "my thing is stone tools", "that starts to ring alarm bells"), and researchers' personal narratives about their research (see example 15) also contribute to establishing a close social distance.

> 15. We had been trying for about a year to kind of observe this amazing phenomenon and we'd had no kind of positive results. And then we saw this quirky phenomenon and I knew what that was and I got very excited. So the next day everyone was there. (V7)

In all but one of the Nature Videos there are in-motion and still images representing content mentioned in the video which do not have an explanatory or elucidating function: their purpose seems to be rather to connect to what is already known by the viewers, to attract their interest and thus keep them engaged. For instance, in V7, the utterance "Based on an effect predicted by Einstein, masers were invented in the 1950" is synchronous with a picture of Einstein.

Other devices to attract the audience's attention and arouse their interest, which also serve to organize content, are the presentation of research as a challenge or problem to solve (with the use of nouns like "challenge", "puzzle", "problem" and negative evaluative vocabulary) (see example 7

above) and questions (e.g. 16). As was said above, some of these videos are constructed to show how the group's research provides the answer to a challenge for researchers or practitioners or to a question posed at the beginning of the video.

16a. How did those rocks get there? (V11)

16b. The hobbits were a new and unique species of ancient human. But where did they come from? and how did they end up so small? (V4)

Another element intended to engage the viewer is the expression of feelings or emotional reaction, both verbally or through gestures (e.g. 17). Researchers express their enthusiasm and excitement when carrying out research, in order to provoke the same feeling or emotions in the viewers.

17a. We're excited about the publication of a research project we've been working on for a few years that, I guess, in a nutshell, we could call the oldest archaeological site here in North America (V6)

17b. I never expected to find the remains of a massacre (V3)

Regarding gestures, they are a ubiquitous resource, used at some moment in all the videos for the expression of emotions and feelings. However, the detailed analysis of gestures is beyond the scope of this study. I have just coded very explicit facial gestures, which are clearly visible and evident for the viewers. As can be seen, this is a frequent resource in Nature Videos, used by researchers when reporting their findings to share their excitement with the viewer. For instance in V6, the researcher reporting their "unbelievable" finding smiles with satisfaction at the end of the utterance in example (17a). Similarly, in V7, when remembering the day when the team managed to produce a continuous room temperature maser one of the researchers says "We were all excited actually, so it was really a great day" while she laughs and smiles broadly.

6. Conclusions

The current communication landscape, where digital technologies bring new affordances for the communication of science, requires a multimodal

approach to the analysis of academic discourse, which accounts for all the elements that contribute to meaning creation in a specific context. In some academic genres, particularly those intended for the public dissemination of knowledge, visual modes play an important role in meaning making and in meeting the audience's expectations and communicative needs. The online science video is one of these genres.

This study has shown that in online science videos a multiplicity of semiotic resources from different modes are co-articulated to realize rhetorical strategies intended to recontextualize knowledge for a wide audience. The videos introduce the research groups and position their members as disciplinary experts by informing of their affiliation to a research institution and by using the affordances of the verbal and visual modes to actually show them "explaining science", "doing science", and using disciplinary equipment and procedures. Speech and image are also interwoven to construct persuasive arguments, with images being used to support the narrative of nature or to provide evidence for claims. Various resources are also combined to establish novelty and newsworthiness, and show the value, relevance and applications of the research carried out by the group. As for the strategies used to make scientific knowledge more comprehensible to the interested audience, definitions and non-technical explanations of concepts, procedures and methods are synchronized with visuals that facilitate understanding. Finally, the strategies to engage the viewers and attain affective engagement are also realized by orchestrating resources of speech (e.g. lexical and grammatical choices which convey intimacy, informality or affinity), image and gestures. The current study has also shown that the various modal resources and elements are multifunctional and can contribute to making different meanings in combination with other resources. The motion image of the researchers explaining or demonstrating procedures, for instance, is combined with other resources to bestow authority on the researchers, make explanations easy to understand, and even engage the audience by showing them how researchers carry out research and obtain findings.

The analysis of two different sets of videos has revealed some differences in the strategies realized in the two sets and the semiotic resources to perform such strategies, which suggests subtle differences in the intended audience and communicative purpose. The purpose of Nature Videos seems to be to inform the interested audience of a recent discovery reported in the journal and to show the relevance and newsworthiness of this discovery.

Presentation Videos are embedded on the groups' websites and the purpose seems to be to show both to peers and to the public the relevance of their research as a contribution to disciplinary knowledge. This explains, for instance, why only Presentation Videos include pictures of the Faculty building to bestow credibility on the researchers, why only Nature Videos present a narrative of nature, why "exclusive we" is used differently in the two sets of videos, and why the strategies and semiotic resources to make content understandable and to connect with the audience play a more important role in Nature Videos. The study therefore contributes to showing that the sign makers combine the multiplicity of generic resources made available by the medium to meet their rhetorical interests. The results of this study provide insights into strategies for the recontextualization of scientific discourse which can be useful for research groups interested in reaching the general public and promoting interest in their research.

Acknowledgements

References

Bateman, J.A. (2008). *Multimodality and Genre.* Basingstoke, UK: Palgrave Macmillan.

Bateman, J.A., J.L. Delin & R. Henschel (2007). "Mapping the multimodal genres of traditional and electronic newspapers" in T.D. Royce & W.L. Bowcher (eds.), *New Directions in the Analysis of Multimodal Discourse*, 147-172. Mahwah, NJ: Lawrence Erlbaum.

Bezemer, J.A. & G. Kress (2008). "Writing in multimodal texts: a social semiotic account of designs for learning". *Written Communication* 25,2: 166-195.

Bondi, M., S. Cacchiani & D. Mazzi (eds.) (2015). *Discourse In and Through the Media: Recontextualizing and Reconceptualizing Expert Discourse*. Newcastle upon Tyne, UK: Cambridge

Scholars Publishing.

Calsamiglia, H. & T.A. van Dijk (2004). "Popularization discourse and knowledge about the genome". *Discourse and Society* 15,4: 369-389.

DeCesare, J.A. (2014). "The expanding role of online video in teaching, learning, and research". *Library Technology Reports* 50,2: 5-12.

Erviti, M.C. & B. León (2016). "Participatory culture and science communication: A content analysis of popular science on YouTube" in C. del Valle Rojas & C. Salgado Santamaría (eds.), *Nuevas Formas de Expresión*, 271-286. Madrid: Ediciones Universitarias McGraw-Hill.

Erviti, M.C. & E. Stengler (2016). "Online science

videos: An exploratory study with major professional content providers in the United Kingdom". *Journal of Science Communication* 15,6: A06. URL: http://eprints.uwe.ac.uk/30236 [01/06/18]

Fahnestock, J. (1986). "Accommodating science: The rhetorical life of scientific facts". *Written Communication* 3,3: 275-96.

Giannoni, D. (2008). "Popularizing features in English journal editorials". *English for Specific Purposes* 27: 212-232.

Hunston, S. (2015). "Talking science: Science in the news on BBC radio" in M. Bondi, S. Cacchiani, & D. Mazzi (eds.), *Discourse In and Through the Media. Recontextualizing and Reconceptualizing Expert Discourse*, 66-91. Newcastle upon Tyne, UK: Cambridge Scholars.

Hyland, K. (2010). "Constructing proximity: Relating to readers in popular and professional science." *Journal of English for Academic Purposes* 9: 116-127.

Jenkins, H. (2007). "From YouTube to YouNiversity". *Chronicle of Higher Education* 53,24: pB9.

Jewitt, C. (2009). "An introduction to multimodality" in C. Jewitt (ed.), *The Routledge Handbook of Multimodal Analysis*, 14-27. London: Routledge.

Kousha, K., M. Thelwall & M. Abdoli (2012). "The role of online videos in research communication: A content analysis of YouTube videos cited in academic publications". *Journal of the American Society for Information Science and Technology* 63,9: 1710-1727.

Kress, G. (2003). *Literacy in the New Media Age*. London: Routledge.

Kress, G. & T. van Leeuwen (2001). *Multimodal Discourse: the Modes and Media of Contemporary Communication*. London: Arnold.

León, B. & M. Bourk (2018). "Investigating sicence-related online video" in B. León & M. Bourk (eds.) *Communicating Science and Technology Through Online Video*, 1-14. New York and London: Routledge.

Luzón, M.J. (2013). "Public communication of science in blogs: Recontextualizing scientific discourse for a diversified audience". *Written Communication* 30,4: 428-457.

Muñoz Morcillo, J.M., K. Czurda & C.Y. Trotha (2016). "Typologies of the popular science web

video". *Journal of Science Communication* 15,4: A02.

Myers, G. (1990). *Writing Biology: Texts in the Social Construction of Scientific Knowledge*. Madison: University of Wisconsin Press

O'Halloran, K.L. (2009). "Historical changes in the semiotic landscape: from calculation to computation" in C. Jewitt (ed.), *The Routledge Handbook of Multimodal Analysis*, 98-113. London: Routledge.

Paltridge, B. (2012). *Discourse Analysis* (2nd edition). London/Sydney: Bloomsbury.

Pasquali, M. (2007). "Video in science". *EMBO Reports* 8,8: 712-716.

Querol-Julián, M. & I. Fortanet-Gómez (2012). "Multimodal evaluation in academic discussion sessions: How do presenters act and react?". *English for Specific Purposes* 31: 271-283.

Ruiz-Madrid, N. & I. Fortanet Gómez (2017). "An analysis of multimodal interaction in a webinar: Defining the genre". *EPIC Series in Language and Linguistics* 2: 274-282.

Santini, L. (2015). "Online edutainment videos: Recontextualizing and reconceptualizing expert discourse in a participatory web-culture". *Journalism and Mass Communication* 52: 51-63.

Scotto di Carlo, G. (2014). "The role of proximity in online popularizations: The case of TED Talks". *Discourse Studies* 16,5: 591-606.

Tang, R. & S. John (1999). "The 'I' in identity: exploring writer identity in student academic writing through the first-person pronoun". *English for Specific Purposes* 18: S23-S39.

Thelwall, M., K. Kousha, K. Weller & C. Puschmann (2012). "Assessing the impact of online academic videos", in G.W. Wulff & K. Holmberg (eds.), *Social Information Research*, 195-213. Bingley, U.K.: Emerald Group Publishing Limited.

Valeiras-Jurado, J., N. Ruiz-Madrid & G. Jacobs (2017). "Revisiting persuasion in oral academic and professional genres: Towards a methodological framework for Multimodal Discourse Analysis of research dissemination talks". *Ibérica* 35: 93-118.

Welbourne, D.J. & W.J. Grant (2016). "Science communication on YouTube: Factors that affect channel and video popularity". *Public Understanding of Science* 25,6: 706-718.

María José Luzón is Senior Lecturer at the University of Zaragoza, Spain. She has a PhD in English Philology and has published papers on academic and professional discourse and on language teaching and learning in the field of English for Academic Purposes. Her current research interests include the analysis of online academic genres and the analysis of ELF in academic online and written discourse.

Appendix: videos making up the corpus

Nature Videos

Brainwaves in Motion: A Wearable Brain Scanner
(https://www.nature.com/nature/videoarchive/brainwaves/index.html) (V1)

Anatomy of a Hunt: Speed Strategy and Survival (https://www.nature.com/nature/videoarchive/hunt/index.html) (V2)

Attack by the Lake: A Prehistoric Massacre
(https://www.nature.com/nature/videoarchive/ancient_massacre/index.html) (V3)

Hobbit Histories: The Origins of Homo floresiensis (https://www.nature.com/nature/videoarchive/hobbit-histories/index.html) (V4)

Pictures in the Air: 3D Printing with Light (https://www.nature.com/nature/videoarchive/3D-printing/index.html) (V5)

The First Americans: Clues to an Ancient Migration (https://www.nature.com/nature/videoarchive/first-americans/index.html) (V6)

The Maser Goes Mainstream Diamond Microwave Lasers
(https://www.nature.com/nature/videoarchive/maser/index.html) (V7)

Presentation Videos

Biomechanics Research Group (https://www.youtube.com/watch?v=nZFvVc3DX-Y) (V8)

BioNano Research Group at Autodesk Research (https://www.youtube.com/watch?v=BSWkaa_f4rg) (V9)

Capsules of Nanotechnology Nanosensors (https://www.youtube.com/watch?v=pnToLYyc_Gs) (V10)

CWI Networks and Optimization Group (https://www.youtube.com/watch?v=KMdb32UDL1g) (V11)

Gadi Rothenbergs Research Group at the University of Amsterdam
(https://www.youtube.com/watch?v=afggRfw0-Ko) (V12)

Research Team Presentation Video: Faculty of Medicine and Dentistry UPV
(https://ehutb.ehu.eus/video/58c66df4f82b2b93748b456d) (V13)

Music Technology Group Presentation (https://www.youtube.com/watch?v=VAfa2GK3NRo) (V14)