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Modes of documentary films produced by the future generation of ‘scientists-as-filmmakers’

Samer Angelone ^{a,b,c}, Ramón C. Soriguer^d and Ana Melendo^a

^aFaculty of Philosophy and Letters, Cordoba University Cordoba, Spain; ^bInstitute of Evolutionary Biology and Environmental Studies (IEU), University of Zurich, Zürich, Switzerland; ^cGlobal Science Film Festival, Zurich, Switzerland; ^dEstación Biológica de Doñana, Consejo Superior de Investigaciones Científicas (CSIC), Sevilla, Spain

ABSTRACT

Six documentary modes are recognised: poetic, expository, observational, participatory, reflexive and performative. Scientists untrained in filmmaking most often choose the expository mode since it possesses the same traits and conventions as used in most scientific narratives. Yet, this need not be the case given that a new generation of ‘scientists-as-filmmakers’, can be taught to appreciate and apply other documentary modes. In this study, we surveyed the possible documentary modes that scientists from nine Swiss universities and research centres would use, both before and after studying filmmaking courses. As expected, before the start of the courses, the majority of the participants (83.33%) said they would use the expository mode, while 27.45% said they would use the observational mode. However, after attending the filmmaking courses, the number of participants interested in the expository mode fell almost by half, while the number of participants who said they would use the observational mode almost doubled. Unexpectedly, after the course the most chosen mode was the poetic (70.58%), and there was also fair amount of interest in the participatory (38.23%) and reflexive (17.64%) modes. The films produced in the future by the generation of ‘scientists-as-filmmakers’ will contain a much greater variety of documentary modes.

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Documentary mode; film course; poetic mode; expository mode; observational mode; participatory mode; reflexive mode; performative mode

Introduction

Communicating science to the lay public is widely recognised to be the responsibility of scientists. General consensus exists within the scientific community that scientific outreach training is needed to restore the connection between science and society (Leshner, 2003). Outreach training should not focus simply on increasing public understanding of science since the problem is not merely one of a lack of scientific comprehension; rather, the issue is more about public engagement than public understanding of science (Leshner, 2007; Lunetta & Dekkers, 1982; Vesterinen, Tolppanen, & Aksela, 2016). Hence, outreach programmes need to be broadened. Science films should be one of the top priorities for outreach training (Angelone, 2019; Lesen, Rogan, & Blum, 2016) since films, which grab people’s attention in a completely different way to traditional articles in journals (De Valck, Rokka, & Hietanen, 2009), are excellent tools for communicating science to peers and the general public (Career Feature Nature, 2018). An easy option would be to delegate the task of creating science films to a handful of professional filmmakers. However, this is not a practical proposal given the huge demand for such films and the breadth of topics and the intensity of effort required. To

CONTACT Samer Angelone  samer.angelone@gmail.com  Faculty of Philosophy and Letters, Cordoba University, Plaza del Cardenal Salazar, s/n, 14071 Cordoba, Spain; Institute of Evolutionary Biology and Environmental Studies (IEU), University of Zurich, Winterthurerstrasse 190, 8057 Zürich, Switzerland; Global Science Film Festival, Imfeldstrasse 25, 8037 Zurich, Switzerland

satisfy the demand for science films, universities and scientific institutes are now teaching their scientists and students how to produce their own science films by setting up accredited filmmaking courses that form part of science communication programmes. This has engendered a new generation of ‘scientists-as-filmmakers’ who ‘assimilate filmmaking as part of their academic preparation, albeit not in a professional way’ (Angelone, 2019). An appreciation of filmmaking has a direct application in science films and also helps improve oral and written science communications (Jones Michael & Anderson Crow, 2017; Martinez-Conde & Macknik, 2017; Olson, 2015).

Outreach programmes in science filmmaking should include training scientists (the new generation of ‘scientists-as-filmmakers’) to appreciate different types of documentary modes and how they can be employed for communicating science to peers and the general public.

In his book *Introduction to Documentary*, the documentary theorist, Nichols (2001) distinguished and discussed six documentary modes based on particular traits and conventions (poetic, expository, observational, participatory, reflexive and performative) used by documentary makers either consciously or simply because they represent filmmakers’ chosen way of telling their stories and sharing their knowledge. Understanding documentary modes, their traits and conventions are essential not just for teaching filmmakers how to analyse documentaries but also for helping them to create their own documentaries.

Expository mode

The ‘voice of God’ mode makes use of narrations that employ scripted (oral or written) commentaries illustrating or simply accompanying footage. This is the most familiar mode – especially to scientists – since it is commonly used in nature and TV documentaries, and aims to educate its audience and explain its subject matter as a documentary essay. These films focus more on facts, objective information and evidence than on evocation of emotions (e.g. *Africa* 2013 by BBC Natural History Unit, and *March of the Penguins* 2005 by Luc Jacquet).

Observational mode

The fly-on-the-wall documentary mode or *cinema verité* views the truth without comment or involvement. Nothing is staged and what we see is completely natural. This mode implies that the filmmakers, equipment and crew are invisible and are unheeded by the filmed subjects. This was made possible by advances in technology during the 1960s and 1970s as sound and camera equipment became easier to use and manoeuvre. This begs the question: how natural can someone be in the presence of the cameras, filmmakers and crew? However, this issue does not necessarily detract from the observational mode itself (e.g. *Salesman* 1969 by Albert Maysles, David Maysles, and Charlotte Zwerin, and *Armadillo* 2011 by Janus Metz Pedersen).

Participatory documentaries

This mode reflects documentaries in which ‘the encounter between filmmaker and subject is recorded and the filmmaker actively engages with the situation they are documenting’ as Nichols explained (2001). This is ‘investigative filmmaking’, i.e. a question is raised or a controversial issue explored and the filmmaker objectively attempts to show on film the audience the progress of their chosen topic. The filmmakers become an integral part of the film, even though they are supposed to be telling a story objectively (*Icarus* 2017 by Bryan Fogel, *Bowling for Columbine* 2002 by Michael Moore, *The Green Lie* 2018 by Werner Boote).

Reflexive documentaries

The reflexive documentary mode stimulates audiences to ‘question the authenticity of documentary in general’. Spectators acknowledge the way a documentary is constructed (the use of the camera,

audio and even editing) and in some cases are as interested in how the film is constructed as the actual content (e.g. *The Man With A Movie Camera* 1929 by Dziga Vertov and *Driving Me Crazy* 1988 by Nick Broomfield).

Poetic mode

The poetic mode ‘moves away from the ‘objective’ reality of a given situation or people, to grasp at an ‘inner truth’ that can only be grasped by poetical manipulation’, as Nichols (2001) stated. The structure of the film is not based on a linear continuity but, rather, arranges shots based on associations, tone and rhythm. The poetic mode, usually associated with avant-garde filmmaking, is subjective and an abstract representation of reality. Special emphasis is placed on visual imagery the film is more reliant on colour, tones, sounds and moods (e.g. *The House Is Black* 1962 by Forough Farrokhzad, and *Samsara* 2011 by Ron Fricke).

Performative documentaries

The performative mode is regarded as the direct opposite of the observational mode. The filmmaker tends to be passionately involved and hence performative documentaries are usually subjective. The performative mode is easily confused with the participatory mode, the difference lying in the fact that, whereas the participatory mode links the filmmaker to the story and attempts to construct truths that should be self-evident to anyone, the performative mode links the filmmaker to the story and constructs subjective truths that are only significant to the filmmaker. Rather than setting out to find the truth, the performative mode shows just one perspective of the truth (*Super Size Me* 2004 by Morgan Spurlock, *Tongues United* 1989 Marlon Riggs).

Documentary modes are not mutually exclusive and the same documentary may make use of one or more of the six above-mentioned modes. There is often significant overlap within one documentary (Nichols, 1994), and even some argue that Nichols’ concept of modes could also be applicable at a micro level (scene-by-scene), (Natusch & Hawkins, 2014). ‘The characteristics of a given mode function as a dominant in a given film ... but they do not dictate or determine every aspect of its organization’, highlighted Nichols (2001).

The main reasons for teaching documentary modes to the new generation of ‘scientists-as-filmmakers’ can be divided into two categories: I. effective communication and II. quality and style.

I. Effective communication

Knowledge of documentary modes is fundamental for understanding the language of documentary films in general and so also of science documentary films. ‘Scientists-as-filmmakers’ in particular and film directors in general require a keen awareness of documentary modes if they are to produce compelling films using the appropriate mode for the message they want to convey and for the audience they are targeting. These documentary modes act as a skeletal framework that ‘scientists-as-filmmakers’ can flesh out according to their creative dispositions.

Through force of habit, scientists untrained in filmmaking typically choose the expository mode (Boon, 2014; Sternberg, 2010) since it possesses the same traits and conventions as are present in most scientific narratives (e.g. scientific papers and presentations) (Sollaci & Pereira, 2004; Williams, 2015). Hence, the new generation of ‘scientists-as-filmmakers’ ought to be encouraged to break free from the dominance of the expository mode (disseminating information or attempting to persuade) and embrace more diverse documentary modes that better fit the desired personal reactions/responses to the films they produce. An option is to follow the AEIOU vowel analogy: Awareness, Enjoyment, Interest, Opinion-forming, and Understanding (Burns, O’Connor, & Stockmayer, 2003). Even so, more studies of how the documentary mode can imbue science films with different meanings are still needed (Little, 2007; Mellor, 2018). For example, the expository mode is especially

appropriate for Awareness and Understanding responses. This mode is relatively straightforward – a ‘show and tell’ structure guiding viewers through the documentary – and is essentially didactic in nature (Boon, 2014; Sternberg, 2010). The observational documentary mode generates above all Awareness and Opinion-forming responses as it aims to adopt an apparently ‘neutral’ stance that distances itself from its subject matter, and simply captures reality as it unfolds (Carta, 2015). The Enjoyment and Interest responses are linked to the poetic mode, which captures moods and feelings and does not attempt to develop any explicit arguments about a subject. This opens the way for alternative forms of knowledge differing from the straightforward transfer of knowledge (Frankham, 2013). The participatory and reflexive modes engender Interest and Opinion-Forming responses. Participatory and reflexive documentaries both highlight the filmmaker’s personal involvement in a film and how it subsequently modifies what happens therein. The participatory mode engages directly with individuals without reverting to mainstream interview styles (Villanueva Baselga, 2015). The reflexive documentary is the most self-aware mode and shows audiences how other documentary modes claim to construct the ‘truth’ by highlighting the artificial nature of film-making (Goodarzi & Tamjidi, 2014). The Performative mode leads to the Enjoyment and Opinion-Forming responses and underscores the links between a subjective knowledge/understanding of the world and more general considerations. In this mode, filmmakers and their subjects create an active documentary via the performance of certain actions (Little, 2007). ‘Scientists-as-filmmakers’ may aim to provoke with their films one or more of the AEIOU responses in viewers, who will include students, members of the public, and representatives from industry, business and government, as well as spectators from the world of science and scientific mediation (Burns et al., 2003).

II. Quality and style

‘Among the many limitations of the deficit model of science communication is its inability to account for the qualities of communication products that arise from creative decisions about form and style.’ (Mellor, 2018). Quality is a crucial issue and an important challenge for contemporary science communication, and style is key when addressing these challenges (Bucchi, 2013). Bucchi stated that ‘Public communication of science should now be mature enough to pass from a “heroic phase”, in which “everything goes” for the sake of communicating science, to a phase in which quality is the central concern for all parties involved.’ Bucchi (2013) advocated a wider-ranging vision of science communication that would provide a vision of science as a central part of the contemporary culture of ‘aesthetics of science communication’. The concept of style enables us to tackle the issue of quality in science communication without imposing either uniformity or any ‘best’ or ‘most appropriate’, ‘one-size-fits-all’ model of science/public interaction. Hence, it is important that the documentary modes used by the new generation of ‘scientists-as-filmmakers’ are as diverse as possible.

Style is another important issue taken into account by science film festivals. As a result of the great increase in demand for science films, science film festivals have burgeoned in recent decades (Bultitude, McDonald, & Custead, 2011; e.g. Bristol Science Film Festival <https://brissciffilm.wordpress.com>; Science Film Festival from Goethe Institute www.goethe.de/ins/th/prj/wif/fes/enindex.htm; Imagine Science Films <http://imaginesciencefilms.org>; Festival International du Film Scientifique Pariscience <https://pariscience.fr>; and Academia Film Olomouc <https://afo.cz>). Science film festivals are more than just simple platforms for circulating science films as they aim to ‘promote science literacy and awareness of contemporary scientific and technological issues through film’ (e.g. Science Film Festival from Goethe Institute) and ‘promote a high-level dialogue between scientists and filmmakers’ (e.g. Imagine Science Films Festival). Consequently, science film festivals are attractive platforms where the new generation of ‘scientists-as-filmmakers’ can screen their films. Yet, getting a film screened at a science film festival is not an easy task since thousands of films are submitted to these festivals and all have to face a rigorous selection process. Documentary modes are one of most important criteria for film selection at science film festivals (and documentary film festivals in

general) and festivals aim to screen films made using a great variety of modes (i.e. not just the expository mode). Science films have better chances of being screened in highly competitive science film festivals if they are filmed using one of the hitherto less-popular documentary modes.

To our knowledge, the educational outreach programmes in science films do not receive nearly as much scholar attention as other outreach programmes (e.g. Angelone, 2019; Angelone, Soriguer, & Melendo, 2019; Vennix, den Brok, & Taconis, 2018). It is not clear how these filmmaking courses for scientists will affect the documentaries produced by the new generation of *scientists-as-filmmakers* in the future and so the aim of this paper is to explore how filmmaking courses may be designed to broaden the use of documentary modes.

Methods

Organisers and participants

In 2015–2018 we studied the chosen documentary modes of 102 scientists (mainly PhD and post-doctoral students) participating in science filmmaking courses organised by seven Swiss universities (Zurich, Geneva, Lausanne, Fribourg, Neuchatel, Basel and ETH Zurich) and two research centres (Swiss Federal Institute for Forest, Snow & Landscape Research WSL and Swiss Federal Institute of Aquatic Science & Technology EAWAG). The scientists, of whom 73 were women and 29 men, came from a variety of scientific backgrounds.

Filmmaking courses for scientists

The analysed science filmmaking courses can be divided into three categories:

I. Theoretical-oriented courses; usually called ‘storytelling and storyboarding science’, with some variations in the exact title.

During 2–4-day courses, 10–50 scientists learn, above all, narrative attributes and techniques of storytelling applied by filmmakers and how to apply them in science communications (e.g. scientific papers, presentation to conferences and didactical material). Some of these courses included attendance at the Global Science Film Festival and Locarno Film Festival. Attending film festivals enables participants to analyse the screened films and talk with professional filmmakers (e.g. Science Film Academy, 2017).

II. Practical-oriented courses; usually called ‘filmmaking for scientists’, with some modifications in the title.

During 2–5 day courses, 10–15 scientists are taught the technical side of science filmmaking and learn how to work with camera, lighting and sound equipment. The theoretical part of storytelling, script, storyboarding and editing techniques is not regarded essential in this type of course. The practical part of these courses includes producing science films that are directly related to participants’ scientific research (e.g. Conférence des Universités de Suisse Occidentale, 2016).

III. Competitive-oriented courses; the so-called science filmmaking marathons.

Forty scientists and filmmakers work for four days in small groups to produce science films after having been taught the basic ideas of filmmaking at the beginning of the course. The aim of these competitive courses is not to produce films directly related to participants’ scientific research but, rather, to practice filmmaking by producing films that relate to science in general (e.g. Swiss Academy of Sciences SCNAT, 2017).

The authors of this paper were responsible for establishing the curricula, and teaching of these filmmaking courses. The modes of documentary films were taught during theoretical sessions on the first day of all courses. In these filmmaking courses, documentary modes have been introduced to broaden the participants' capacity of making relevant choices in the process of filmmaking.

Questionnaire

Before answering the questionnaire, participants were asked to think in detail about the films that they would like to make in the future. With a clear vision in mind, participants were then taught the six documentary modes (Nichols, 2001). Finally, participants answered the questionnaires regarding the documentary modes that they would have used before attending the filmmaking courses and the ones that they would use in light of the course content. Each participant could choose more than one documentary mode.

Statistical analyses

The frequency analysis χ^2 (Pearson's Chi-squared test *X*-squared) was used to compare the frequencies of the used narrative modes before and after the courses. Fisher's Exact Test for Count Data was applied to compare the frequencies of the narrative modes used by female and male participants. To compare the number of types of narrative modes chosen before and after the filmmaking courses, nonparametric statistical tests (Wilcoxon signed rank test with continuity correction and Spearman's rank correlation coefficient) were used. All analyses were carried out using R Package V.2.15.1 (R Development Core Team, 2008).

Results

Preferred modes differed before and after the workshops (*X*-squared = 95.499, *DF* = 4, *p*-value < 2.2e-16). As expected, before the filmmaking courses the majority of participants (83.33%) said they would have used the expository mode, while just 27.45% said they would have used the

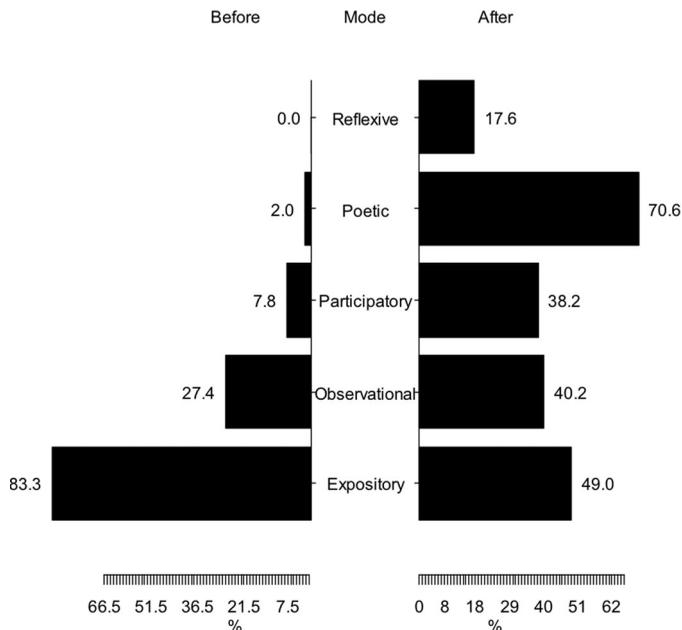


Figure 1. Changes in the choice of the 'possibly used' documentary modes before and after the filmmaking courses. After the courses only two participants opted for the performative mode (data not shown in the graphic).

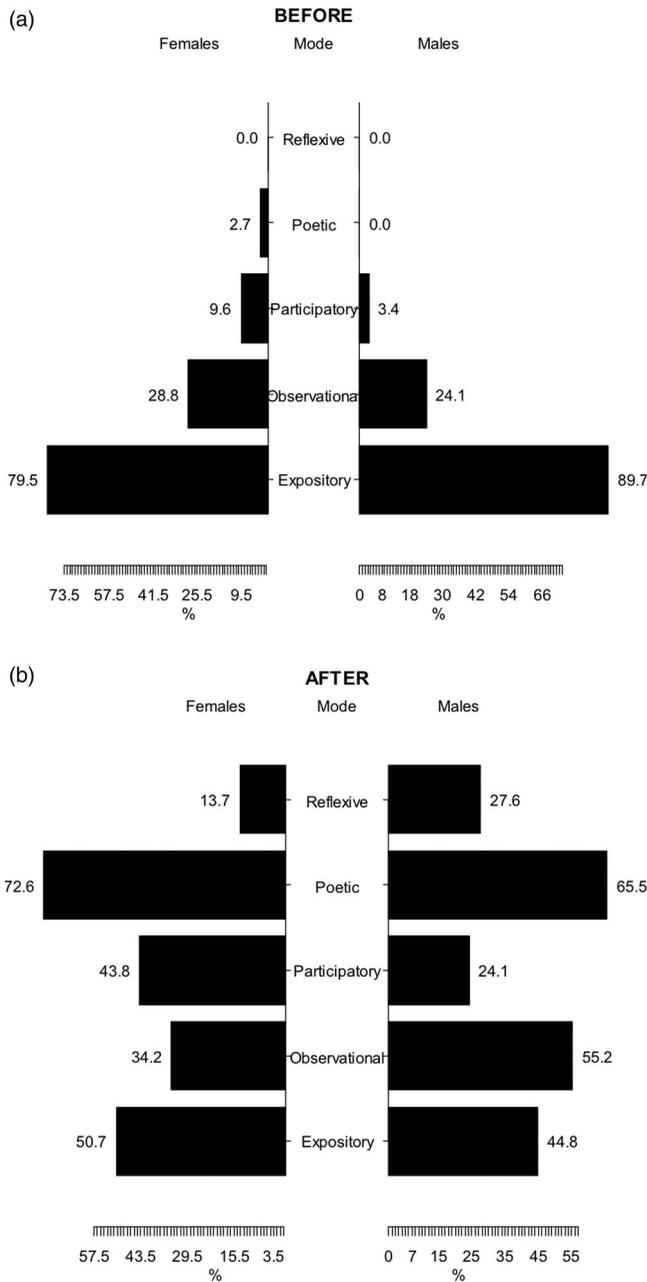


Figure 2. The documentary modes chosen by female and male scientists before (A) and after (B) the filmmaking courses.

observational mode. Only 7.84% and 1.96%, respectively, of participants said they would have used either the participatory or poetic modes. Before the filmmaking courses, no participants showed any interest in the performative mode. However, after attending the courses, the number of participants potentially interested in the expository mode fell almost by half (49.02%), while the number of participants who said they would use the observational mode almost doubled (40.19%). Unexpectedly, the mode most often chosen by scientists after attending the filmmaking courses was the poetic mode (70.58%), and there was also much more interest in the

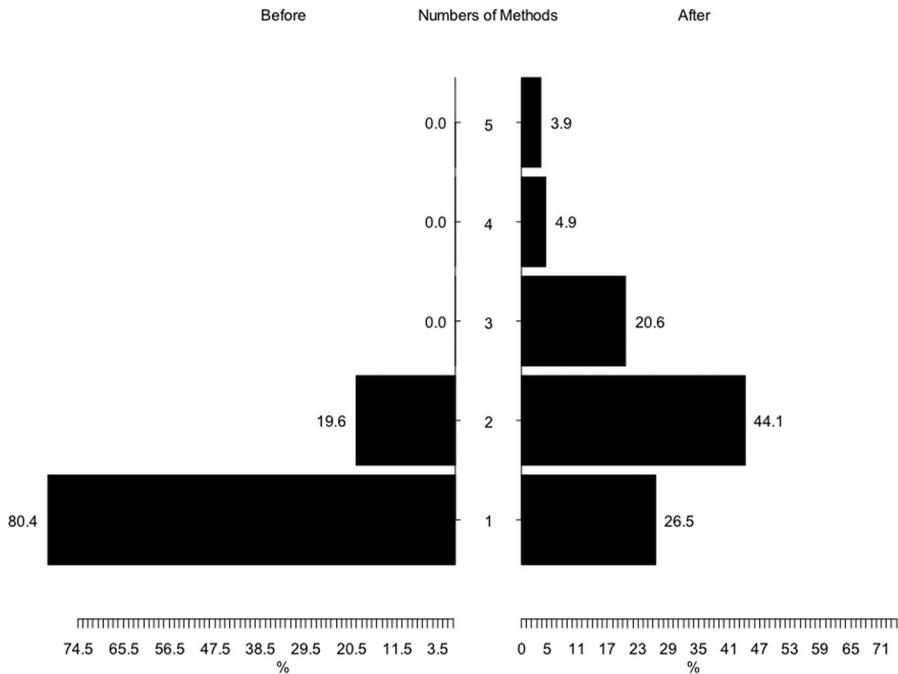


Figure 3. Changes in the number of the 'possibly used' documentary modes before and after the filmmaking courses.

participatory and reflexive modes, which 38.23% and 17.64% of participants, respectively, said they would consider using (Figures 1–2). No participants before the courses showed any interest in the performative mode; however, two female participants opted for this mode after the workshop (data not shown in the figures).

The filmmaking courses not only changed participants' choices of documentary modes but also increased the overall number of modes that they said they would consider using (Pearson's Chi-squared test, $X^2 = 67.368$, $df = 4$, $p\text{-value} = 8.155e-14$, and Spearman's rank correlation coefficient 0.303, $p\text{-value} = 0.002$). Before the courses, 80.39% of participants said they would have only used one documentary mode and 19.61% two modes. Yet, after the courses, the number of participants interested in just one mode fell to 44.12% and the number of participants interested in two modes increased to 26.47%. In addition, 20.59%, 4.9% and 3.92% of participants said they would consider using three, four or five different documentary modes, respectively (Figure 3).

In all, 72% of the scientists who attended the filmmaking courses were female. There were no statistical differences between female and male scientists regarding choices of documentary modes either before (Fisher's Exact test, $p\text{-value} = 0.144$) or after (Fisher's Exact test, $p\text{-value} = 0.678$) the filmmaking courses.

Conclusion & discussion

The documentary modes proposed by Nichols (2001) are considered as 'rational discourse'. However, in her book *Looking Two Ways*, Toni De Bromhead (1996) criticises this 'rational discourse' of Nichols arguing that a documentary reaches people through their 'hearts and souls not just minds' and that what is really essential to documentary storytelling is 'emotional response and empathy'. Nevertheless, this 'rational discourse' is very appropriate for the scientists on the filmmaking courses as, due to their 'rational scientific background', it is easily understood.

With no filmmaking background the expository mode is the most logical one for a scientist to use. It possesses the same traits and conventions as scientific narratives and bolsters the notion of objectivity and authenticity (e.g. scientific papers and presentations; Boon, 2014; Sollaci & Pereira, 2004; Sternberg, 2010) since, even if most scientific research is mainly based on observation, scientific communication is based on exposition. The observational mode was the second option, a choice that, likewise, can be explained by the observational methodology of scientific research. However, our questionnaire did not include details about participants' scientific background, the purpose of the films and the targeted audience. Only few scientists opted for the participatory and poetic modes, which could be attributed to their lack of knowledge of these modes and of the possibilities these modes offer.

The filmmaking courses changed scientists' preferred documentary modes. The expository and observational modes would still be used by the 'scientists-as-filmmakers' but less often. Surprisingly, the potentially most-used mode was the poetic mode. This could be due to a real need for communicating science emotionally to the wide audience, or simply because this mode was novel. Scientists were also interested in the participatory mode since, if a question is posed or a controversial topic is raised, and the filmmaker is involved in objectively showing the audience the filmmaking process of their subject, then the creative process can be regarded as 'investigative filmmaking'. This resembles the scientific mentality of first posing a question and then objectively seeking the answer.

The scientists did not find the performative mode very attractive and after the filmmaking course it was the first choice of only two female participants. This could be attributed to the traits and conventions of this mode, which is thought of as being the opposite of the observational mode, and hence scientists may regard it as 'manipulative'. The performative mode links the filmmaker to the story and constructs subjective truths. This type of 'subjective truth' could work for some scientists as a contrast to the scientific concept of truth, or simply be the mode that best suits the audience they have in mind. But this need not always be the case. Although performative documentaries at first glance seem to have little in common with traditional documentary modes of science communication, a study by Little (2007) claims that 'the performative mode of documentary filmmaking is an emerging, intrinsically powerful and virtually unexplored weapon in the arsenal of science documentary'.

Although it was expected that filmmaking courses would change scientists' preferred documentary modes, the direction (from expository mode to one or more of the other modes) and the dimension of this change were not clear. These changes could be attributed to the need for appropriate modes for effective science communication or for reasons connected to quality and style (Little, 2007; Mellor, 2018).

The significant increase in the range of preferences of documentary modes after the filmmaking courses may reveal a real need corresponding to the film projects that participants have in mind; that said, it may simply be a reflection of scientists' desires, stimulated by the courses, to try out as many modes as possible.

More women than men attended the filmmaking courses; there were no statistical differences between genders in the choices of the documentary modes. Gender bias in our study has no consequences in the validity of the results, due to the relatively high sampling size (101 participants) and the fact that gender bias is normalised in the used statistical methods. However, the extent of gender bias in science and art is an on-going debate and some authors argue that art education is woman-stereotyped (Dalton, 2001). This clear gender bias means more young (participants in the filmmaking courses were mainly PhD and post-doctoral students) female *scientists-as-filmmakers*, but how this bias might affect the future of science communication to the public is not yet clear, since there is another gender bias playing out against women in academic hiring, tenure and promotion, as well as in science communication (Knobloch-Westerwick, Glynn, & Huge, 2013; Powell, 2018).

We believe that there was no data bias between groups because the same teachers using the same didactical material took all the filmmaking courses. We also believe in the replicability of our results, however these results could be slightly affected by the scientific background of the participant

scientists and/or their targeted audiences, as well as by the didactical materials and teaching styles of the teaching staff. None of these three factors were considered in the study.

This study highlights the importance of the filmmaking courses that universities and scientific institutes worldwide offer their students and scientists as part of outreach programmes designed to encourage them to produce their own science films. The time limitation of these workshops (usually between 1 and 3 days) restricts their focus in many times to the technical parts (camera, sound, lighting, editing ... etc.), neglecting fundamental parts of filmmaking, like narratives and documentary modes (Angelone et al., 2019). Therefore filmmaking courses for scientists might be designed to facilitate a broadened perception of documentary filmmaking among scientists, so that the forthcoming generation of 'scientists-as-filmmakers' can make use of a greater variety of types of documentaries, which is pivotal for effective science communication, with quality and style.

Filmmaking courses for scientists and the science films produced by the coming generation of 'scientists-as-filmmakers' require wider and more multidisciplinary scholarly study in two fields, namely, science education and science communication. The content and outcomes of educational filmmaking courses for scientists still need to be thoroughly evaluated and in-depth analyses of this type and the impact of science films on audiences should be incorporated into film and media studies.

Disclosure statement

No potential conflict of interest was reported by the authors.

ORCID

Samer Angelone  <http://orcid.org/0000-0003-0868-7276>

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