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Infotainment May Increase Engagement with Science but It Can Decrease Perceptions of Seriousness

Lloyd S. Davis [1,*], Bienvenido León [2], Michael J. Bourk [3], Lei Zhu [1] and Wiebke Finkler [4]

[1] Department of Science Communication, University of Otago, Dunedin 9054, New Zealand
[2] School of Communication, University of Navarra, 31009 Pamplona, Spain
[3] Mass Communication and Media Department, Gulf University for Science and Technology, Mubarak Al-Abdullah Area, West Mishref, Kuwait City 32093, Kuwait
[4] Department of Marketing, University of Otago, Dunedin 9054, New Zealand
* Correspondence: lloyd.davis@otago.ac.nz; Tel.: +64-21-617-176

Abstract: We presented 867 participants with one of two videos about climate change that differed only in terms of whether they had an infotainment or expository narration. They were available in either English or Spanish. The participants consisted of two distinct clusters: one in which all were over 30 with a university degree, and another dominated by younger participants without a university degree. The infotainment version produced a significantly reduced perception of the seriousness of climate change for the planet in the latter cluster. Furthermore, viewers of the English versions, who were predominantly residents in countries with low-context cultures, perceived the risk of climate change for the planet to be significantly higher after watching the video with the expository narration. Using infotainment for science communication is a two-edged sword: while it may help engagement, making light of a topic can reduce perceptions about its seriousness. We suggest that the use of infotainment should be determined by the aims of the communicators and the nature of the target audience. If the purpose is simply to convey information, then infotainment is likely to be the most effective and it has the additional benefit of engaging recipients that lack a university education. However, if the purpose is to affect attitudes and persuade an audience, then an expository narration is likely to be most effective.

Keywords: science communication; environmental communication; public perception of science and technology; science and media

Citation: Davis, L.S.; León, B.; Bourk, M.J.; Zhu, L.; Finkler, W. Infotainment May Increase Engagement with Science but It Can Decrease Perceptions of Seriousness. *Sustainability* **2022**, *14*, 10659. https://doi.org/10.3390/su141710659

Academic Editor: Andrei P. Kirilenko

Received: 16 June 2022
Accepted: 21 August 2022
Published: 26 August 2022

1. Introduction

There are facets of society that do not respond well to direct forms of science communication about such topics as human-induced climate change. In particular, education, age and gender can affect perceptions of climate change [1,2]. As one way to address this disparity in reactions to messaging, Wozniak, Lück and Wessler [3] argued for using a multimodal approach to communication that includes the use of comedic narratives that form the basis of infotainment (information combined with entertainment).

Humor can be an excellent way to facilitate engagement with science both in person [4] and online [5]. Indeed, the use of humor in online videos as part of an infotainment-style narration has been shown to improve acquisition and recall of information about science-related subjects such as climate change [6].

Viewing online videos on social media platforms such as YouTube, Facebook and TikTok has become the fastest-growing segment of media consumption in society [7], where user-generated content (UGC), especially, is consumed for infotainment [8]. The popularity of infotainment-style user-generated online videos provides a potential opportunity to communicate science, especially to the harder to reach areas of society [6].

In addition to humor (i.e., providing amusing content), infotainment in user-generated online science videos is typically defined by the use of storytelling [9] and popular personalities [10]—all of which can contribute to their popularity [7,10]. Infotainment is considered an important strategy for telling stories in popular online videos about science [11] and viewers of such online science videos are more likely to recall information because they regard it as relevant to themselves [12]. However, there are potential downsides to using infotainment in videos, in that it may reduce the perception of seriousness [13] or even give a wrong impression altogether [14].

Given the popularity of online videos and the potential positive effect that an infotainment style of narration can have on engagement, we set out to test whether online videos that use an infotainment style can be a useful tool for communicating the risks of climate change and enhancing perceptions of the relevance of climate change.

1.1. Perceptions

The media play an important role in shaping public perceptions and attitudes towards climate change. Most often, media tend to focus on sensational elements: conflict and debates [15,16], uncertainty [17] and the partisan dimensions of an issue [18–20]. This variety of perspectives can create an impression that there is no clear scientific consensus on a topic and, ironically, viewers' perceptions about the relevance of a topic like climate change in online videos may be more affected by their personal biases than a video's actual content [21].

The way in which a message is emphasized or constructed has an effect on how a receiver interprets the message [22,23]. In this study, we compare the effect of two forms of stylistic narrations in online videos on an audience's perception about climate change: the infotainment style and the expository style. The expository style of narration is that in which a narrator addresses the viewer directly, usually through a voice-over narration that conveys the impression of objectivity and well-grounded argumentation [24]. It is the mode of representation employed in most documentaries [25], allowing it to serve both educational and propaganda purposes [26].

By contrast, an infotainment style of narration is, as the name suggests, a combination of information and entertainment [27–29]. Infotainment has become an increasingly popular style of narration in online videos about science [8]. In spite of that, research on the impact of infotainment on perceptions about climate change is scarce, e.g., [30,31]. Davis et al. [6] showed that viewers of an online video about climate change without a university degree had a distinct preference for a narration that used an infotainment style, whereas those with a university degree were most likely to prefer and believe narrations that were presented in an expository style. However, there is no empirical evidence about how narration styles in online videos may affect viewers' perceptions of climate change.

From the perspective of science communication, not only is an understanding of the science about climate change and a preference for its means of delivery important, but also the perceptions and awareness of its relevance are also important aspects of effective communication [32]. It is crucial, therefore, to understand not just how an infotainment style may affect information transfer about climate change, but how it impacts attitudes about climate change: does making jokes about climate change undermine its seriousness or bolster the public's appreciation of its seriousness [33]?

1.2. Infotainment

Infotainment can be regarded as part of the wider trend for entertainment that has been one of the key driving forces in television for the last few decades [13,34–36]. However, with the rise of the internet and videos streamed online and on-demand, infotainment has become a much more prominent feature, especially for UGC [7].

Despite its increasing prominence, conveying information in the form of infotainment has often been criticized. Some critics argue that infotainment increases the amount of irrelevant information, displacing the relevant information [37], to the point that what is trivial can overcome what is important [38]. It is also argued that infotainment is often linked to

sensationalistic approaches in which the style is more important than the substance, where the entertainment factor becomes more relevant than the content itself [28].

Indeed, infotainment is sometimes described as being "cultural fast food" because when users digest relatively serious science information that way, they are most likely to be affected by sensationalism and the personalities of the information providers [39,40]. Some have even contended that when information adopts the characteristics of spectacle, as it often does when using an infotainment style of narration, this degrades actuality [41] and creates "misinformation" under the illusion of knowledge [37]; a related phenomenon to that which has become prevalent in society recently as "fake news" [42,43].

Others argue that infotainment is an open door to a more democratic public discourse [44] as it produces a type of content with wide popular appeal that makes information accessible to certain social groups that are not otherwise interested in traditional information [6,45,46]. Infotainment is also believed to be a powerful means of communicating science, irrespective of social groupings, especially when the content is complex and controversial [39]. As a consequence, it is used widely for popularizing science in online video channels [9,47].

1.3. Defining Infotainment

The most prevalent strategies used to build infotainment content based on science topics are: (i) structuring content through stories, (ii) personalization and (iii) the use of humor [6], and this is especially so when communicating issues relevant to climate change [48].

1.3.1. Storytelling

A story provides structure that helps to organize the ideas in a similar pattern to that of most fictional films: a protagonist has a well-defined objective and is immersed in a succession of events, but encounters difficulties, resulting in a conflict that finally leads to a resolution. This way of structuring scientific content can be effective, as it employs a narrative scheme that is familiar to the viewer and, at the same time, it provides a guiding thread that keeps the viewer oriented [25].

The use of storytelling, in contrast to non-narrative forms [49], can allow for more effective communication as it can increase audience engagement and memory recall [50]. Storytelling can enhance learning by connecting the causes and consequences of climate change in a sequential narrative [51].

1.3.2. Personalization

Personalization, which helps a viewer relate to characters on the screen, is regarded as an essential element of entertainment [52] and, by extension, an important narrative device to create infotainment. Characters can help present scientific facts in a way that facilitates identification in the viewer, revealing a human aspect with which the public can connect. Online science videos with a consistent personality presenting them are more popular [10].

1.3.3. Humor

Humor is a very important and prominent dimension of infotainment, and has become more prevalent in public communication about science [53]. Humorous science audiovisual content includes ingredients that are designed to increase the entertainment value, such as anecdotes, curiosities and funny expressions. Exposure to such humor (e.g., political satire), has been found to influence attitudes to the subject of the humor, especially in young adults [54]. In an examination of 826 online science videos, nearly a quarter of them (23%) used elements of humor [8].

These three dimensions of infotainment—stories, personalization and humor—were used in this study to define and produce an infotainment style of narration.

1.4. Cultural Influences

Hofstede et al. [55] make a distinction between universal human nature, which is shared by all people, and cultural influences, which are "the collective programming of the mind that distinguishes the members of one group of people from others." Different cultures may be classified according to six dimensions [56]. Another dimension, which more or less encapsulates those of Hofstede, is Hall's concept of a continuum from low-context to high-context cultures [57,58]. Although the notion of low- and high-context cultures has been criticized in principle as being too simplistic, static and outdated given our fluid global societies [59], it has nevertheless proved to be a useful and robust measure to describe and interpret patterns of communication in a number of contexts [59–61]. Communication in high-context cultures tends to be more indirect, reserved and understated, with an intention to maintain harmony and a preference for nonverbal cues, while communication in low-context cultures is more direct, precise and open, being based on feelings or intentions [59,62]. Low-context cultures place the emphasis on what is said, while high-context cultures emphasize the context, such as who said it, when, why, how, where and to whom was it said [63].

Expository narrations, which are designed to lay out the facts, would be expected to appeal to low-context cultures especially. Such an approach is likely to be less appealing to high-context cultures, which we hypothesized would prefer the personality-driven story-telling of an infotainment approach. Spain is an example of a high-context culture, whereas, generally, countries with western European roots represent low-context cultures (e.g., much of Europe, Scandinavia, the United States, Canada, Australia and New Zealand) [58]. Although it is beyond the scope of this study to measure culture *per se*, by conducting our experiment in both Spanish and English, we can use language as a proxy for high- and low-context cultures [64,65].

1.5. Research Aims and Questions

This research aims to provide empirical evidence about whether infotainment affects a viewer's perception about the seriousness of climate change.

We posed three specific research questions:

- Research Question 1 (RQ1): Can an infotainment style of narration differentially affect a viewer's perception of climate change as a serious issue for the planet compared to an expository style of narration?
- Research Question 2 (RQ2): Can an infotainment style of narration differentially affect a viewer's perception of climate change as a serious issue for his/her own life compared to an expository style of narration?
- Research Question 3 (RQ3): Can cultural influences associated with the language used for a narration and a viewer's country of residence affect perceptions of climate change as a serious issue either for the planet or themselves?

2. Materials and Methods

2.1. Online Videos and Narrations

We constructed two identical videos about climate change using footage available to us and stock footage. The videos were 2 min 52 s in length. The videos differed only in their narration. One was written in an expository style, where the information was provided in the serious voice of an omniscient narrator using the formal language characteristic of a science documentary (the expository version). The other was written from a first-person point of view in a personable, entertaining style whereby the narrator introduced himself and spoke using colloquial, humorous and glib language (the infotainment version). In order to test the effect of narration style, we kept all other variables constant in the videos being tested here and, similar to the methodology used by Spartz et al. [66] to examine perceptions of online videos about climate change, participants were presented randomly with one of two conditions: either the video with the expository narration or the one with the infotainment narration.

2.2. Constructing the Infotainment Version

To construct the infotainment version, we employed the three narrative strategies, identified above, which are typically used to build infotainment content about science: (i) structuring content with a story, (ii) personalization and (iii) the use of humor. Firstly, in our infotainment version, the protagonist—a climate scientist—must endure hardships in order to collect the data that will convince us that climate change is threatening our futures and requiring us to act now (for a full transcript of the narrations see Table 1). Secondly, personalization helps the viewer relate to the characters on the screen [52] and, in our example, the scientist is introduced as Jeremy Johnson and the narration is from his first-person point of view. Thirdly, with humor being a very prominent dimension of infotainment [53], in our example, the infotainment version of the narration contains a number of humorous asides (Table 1).

Table 1. The expository and infotainment styles of narration relative to the video sequences.

Sequence	Expository Narration	Infotainment Narration
ANTARCTICA, SCIENTISTS	There exists a strong consensus within the scientific community that the Earth is warming, and that this is mainly as a consequence of human activities that pollute the atmosphere with tons of CO_2 and other greenhouse gases. Here, in west Antarctica, research has shown that the ice is melting faster and faster and the amount of ice cover is shrinking.	I'm Jeremy Johnson, I'm a climate scientist and, ironically, I'm freezing my arse off just to prove to you, along with my fellow scientists, that the Earth is getting warmer as a consequence of all the crap like CO_2 and other greenhouse gases we are spewing into the air. Here in west Antarctica, my research indicates the ice is disappearing faster than money in a Greek bank.
ANIMATION OF PLANET EARTH	But this is happening all over the planet. As the concentration of greenhouse gases has increased, temperatures have risen and the quality of life is diminishing for many of us.	In fact, be it Athens or Zurich or anywhere else, it's the same story: greenhouse gases driven into the atmosphere mean that life on Earth is getting less like Heaven and more like Hell.
OCEAN	Measurements scientists have taken of sea surface temperatures show with a high degree of probability that the oceans are getting warmer.	I've endured seasickness sampling the seas from Antarctica to the Arctic: and all over the planet, the oceans are getting warmer.
ICE MELTING	Scientists working at a lake in the Arctic have made a significant discovery: sediment cores taken by the scientists from the lake floor suggest a pattern whereby the loss of Antarctic ice has in the past accelerated the disappearance of the entire Greenland ice sheet.	In the Arctic, sediments taken from the bottom of a frozen lake I walk on with care, suggest a worrying link with my Antarctic work: the loss of ice in Antarctica could trigger the loss of the entire Greenland ice sheet. The whole freaking lot. Zippo. Zilch. Nada. Nothing left.
LONDON, NEW YORK	If that were to happen again, it would raise the sea levels around the globe by 7.2 meters.	Say goodbye to most of London and New York: sea levels would rise by over 7 meters.
ELEPHANT, KILAMANJARO GLACIER	Around the world, measurements have shown that glaciers continue to shrink.	From Africa to Argentina glaciers are retreating at a speed that only an Iraqi soldier could admire.
FLOODING, FIRE	Extreme weather events, like heat waves, floods and snow storms are now more frequent.	Global warming doesn't just bring hot weather; it can also bring storms and floods at the other extreme.
PENGUINS, MUSK OX	Climate change is affecting all forms life of on Earth, provoking changes in animal behavior and a loss of biodiversity.	Animals like Musk Ox and Penguins must adapt to life with less snow—or go extinct and add to climate change's toll on biodiversity.

Table 1. *Cont.*

Sequence	Expository Narration	Infotainment Narration
HUMANS, DESERT	Humans beings are also affected. Climate change has a negative impact on water resources and freshwater ecosystems all over the world. In the near future, it will increase the spread of infectious diseases, like malaria.	We are also affected. Global warming is hitting us where it hurts: in our waterworks. And if dying of thirst or hunger or from contaminated water weren't bad enough, it increases our risk of dying from diseases like malaria.
REFUGEES	Weather related disasters and desertification are already causing displacement of people. Scientists estimate that 150 million environmental migrants will exist by the year 2050, due mainly to flooding and agricultural disruption.	Little wonder that so many of us just want to get the hell out of where we live: by 2050, I estimate 150 million of us will be environmental migrants as we set out to escape floods and famine.
ANTARCTICA, CLIMATE CHANGE ROAD SIGN	In Antarctica and elsewhere, the research into climate change continues. According to experts, a substantial reduction in human production of greenhouse gas emissions is what is required to reduce climate risks in the 21st century and beyond.	I continue to study climate change in Antarctica in weather that would freeze the balls off a brass monkey. But the inconvenient truth is that the world really is getting warmer and the culprit really is us. We must reduce our greenhouse gas emissions . . . or else . . .

2.3. Narrations and Information

Despite differences in their narrative style and framing, the key information about climate change was the same in both versions of the videos that we produced (Table 1). Additionally, one of us (B.L.) translated the narrations from English to Spanish, so that expository and infotainment versions of the films could be made available in both languages. Two of us (B.L. and L.S.D.) have professional experience directing and narrating films: both English versions were narrated by L.S.D. and both Spanish versions were narrated by B.L. Hence, although the style of delivery was different between the expository and infotainment versions of the film, for each language, the voice was also the same for the expository and infotainment narrations.

2.4. Survey

We conducted an online survey using SurveyMonkey by directing participants to a website set up to run the experiment: www.sciencefilms.org. The call to participate in the survey was distributed via personal and institutional social media and email, and the survey was kept open for four months (1 October 2016–31 January 2017). In accordance with the certificate (2016.126) issued by the Ethics Committee of the University of Navarra, participants were told the survey was part of an international study about science-related online videos with the purpose of assessing their thoughts and knowledge about such online videos. However, in order not to influence their responses, they were not told what specific aspects of the videos we were investigating (i.e., their responses to two different types of narration).

Participants first chose whether to take the survey in English (n = 418) or Spanish (n = 449), giving a total sample size of 867 respondents. Initially they were asked three pre-test questions (Table 2) using a five-point Likert scale for their answers (which were recorded as ordinal values, 1–5) about the importance of three scientific issues (human cloning, carbon dioxide emissions into the atmosphere and a vaccine against malaria). This was to assess their attitudes to science before viewing the video. They were then directed to watch a video and were randomly presented with either the expository or infotainment versions of the video in the language they had selected. After watching the video, respondents were asked to select appropriate answers from the options available for six questions about their personal information (country of residence, gender, age,

educational level, online video viewing habits and online science video viewing habits). Using a five-point Likert scale (also recorded as ordinal values 1–5), they were then asked two post-test questions, which were the specific focus of this study, about their perceptions gained from watching the video: (i) Does the video leave you feeling that climate change is a serious issue for the planet? and (ii) Does the video make you feel that climate change has an impact on your own life? (Table 2).

Table 2. Pre- and post-test questions asked before and after seeing the video with either the infotainment or expository style narration.

Pre-test Questions
(5-point Likert Scale from "Not important" to "Very important")
How important do you consider the following scientific issues to be:
1. Developing new techniques for human cloning?
2. Reducing CO_2 emissions into the atmosphere?
3. Finding a vaccine against malaria?
Post-test Questions
(5-point Likert Scale from "Not at all" to "Extremely")
1. Does the video leave you feeling that climate change is a serious issue for the planet?
2. Does the video make you feel that climate change has an impact on your own life?

2.5. Analysis

In order to examine the specific influence of narration styles on different facets of the audience, participants in the online survey were classified into clusters according to their demographic characteristics, habits of watching online videos and attitudes towards science by means of cluster analysis [67,68]. Cluster analysis is a widely used method to classify participants according to internal and external variables and analyze the characteristics (e.g., attitudes towards products) of different groups in social and commercial research [67,69,70]. It proved an appropriate method to organize participants into meaningful clusters, whereby participants within each cluster shared a relatively high similarity while those in different clusters had different characteristics. We used cluster analysis in this study because it is particularly useful when exploring whether participants with similar pre-existing attitudes and socio-demographics may have similar experiences, perceptions or responses to an experimental manipulation (i.e., in this case, whether they viewed the video with the expository or infotainment narration) [71,72]. The use of cluster analysis helped to separate the sample population into clusters (groups), which were described by a set of characteristics such as demographic traits, pre-existing attitudes and cultural backgrounds. The use of cluster analysis, therefore, allowed us to compare the effectiveness of the video and the role of narration by the segmentations of participants with similar characteristics, which is more meaningful and practical than treating individual independent variables separately (e.g., using a General Linear Model, GLM). Where cluster analysis indicated significant underlying differential effects based upon the type of narration, however, we combined the data from all clusters and used separate two-factor ANOVAs to determine whether the differences were apparent across the whole sample regardless of age, education or gender [73].

Specifically, the demographic variables entered in the cluster analysis were age, gender and education. Attitudes towards science were calculated based on the average score of each participant's answers to the three relevant items in the pre-questionnaire about science (human cloning, reducing CO2 emissions and finding a vaccine against malaria), with the average determining one of three possible levels for the participant's attitudes to science (negative, neutral or positive).

As the sample size was large and most variables involved in the analysis were nominal and ordinal, a two-step cluster analysis was adopted here [68,74]. This type of analysis includes two phases: first, participants were pre-clustered into small subclasses according to the variables entered in the analysis. Next, these subclasses were grouped into the larger final clusters by means of hierarchical clustering. The final number of clusters

was determined based upon the comparison of Schwarz's Bayesian Criterion (BIC). Log-likelihood was used to measure the distance between clusters [70].

Finally, the participants' responses to the two specific questions of interest—about the seriousness of climate change for the planet and its impact on their own lives—were then examined comparing the different narrations within each cluster and, also, the responses were compared between clusters. We also examined whether there were differences in the responses to these two questions depending upon the language of the narration viewed by participants as a proxy for any cultural differences in communication. The results were processed using SPSS statistical software. Statistical significance of differences in means was tested with one-way or two-way ANOVAs [73].

3. Results

The online survey was effective in recruiting a large sample. In all, 867 responses were gathered (418 in English, 449 in Spanish). Females constituted 58.9% of participants, while 41.1% were males. Participants came from 46 different countries of residence.

The distribution and patterns of the answers were highly similar for both the English and Spanish participants and their sample sizes were also similar. Furthermore, the language of the video had no significant impact upon whether viewers found either the expository or infotainment version of the narration likeable or believable [6]. Hence, for the purposes of examining differences between expository and infotainment narrations for communicating climate change, the results were initially combined for those taking the survey in English or Spanish, producing combined sample sizes for those who watched the expository (n = 446) and infotainment (n = 421) versions.

Participants self-identified as having the following weekly habits of watching online videos on any topic: less than 15 min (14.7%); from 15 min to 1 h (22.8%); from 1 h to 2 h (16.8%); more than 2 h (20.3%). Their declared weekly habits of watching online video about science were as follows: less than 15 min (42.6%); from 15 min to 1 h (26.9%); from 1 h to 2 h (8.9%); more than 2 h (4.4%).

3.1. Characteristics of Clusters

If a participant had one or more missing value for the five variables involved in the cluster analysis (i.e., the participant had skipped one or more relevant question when completing the questionnaire), the answers of that participant were excluded from the analysis. The usable sample size, therefore, was 643. Overall, two distinctive clusters were generated from the two-step cluster analysis (Figure 1). The first cluster included 347 participants (54.0%), while the second contained 296 participants (46.0%). All the variables involved in the cluster analysis have significantly different distributions of their levels between the two clusters, suggesting the difference in characteristics between the two clusters is distinctive (Table 3).

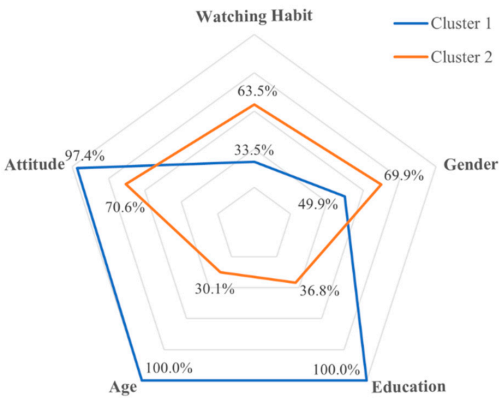

Figure 1. The percentage radar chart shows how the characteristics of the two clusters differ from each other. Five dimensions (age, gender, education, watching habit and attitude) were used to describe the

clusters. Age: the percentage of older participants (30 years old or older) within each cluster; Gender: the percentage of female participants within each cluster; Education: the percentage of participants with university degrees within each cluster; Watching habit: the percentage of participants who spent more than one hour per week watching online videos within each cluster; Attitude: the percentage of participants who had a positive attitude towards science within each cluster. The center of the chart represents 0% while the maximum edge of each dimension is 100%.

Table 3. Characteristics of age, gender, education, habits of watching online videos and attitudes towards science in the two clusters produced by two-step cluster analysis. Significance represents whether the distribution of levels of each variable was different between clusters. The dominant groups of each variable within clusters are marked by asterisks.

Variables	Levels	Cluster 1 (%)	Cluster 2 (%)
Age $\chi^2 = 300.35$ $p < 0.001$	18~29 years	0 (0%)	207 (69.9%) *
	30~49 years	205 (59.1%) *	65 (22.0%)
	>50 years	142 (40.9%)	24 (8.1%)
Gender $\chi^2 = 26.60$ $p < 0.001$	Male	174 (50.1%) *	89 (30.1%)
	Female	173 (49.9%)	207 (69.9%) *
Education $\chi^2 = 153.62$ $p = 0.001$	With university degrees	347 (100%) *	109 (36.8%)
	Without university degrees	0 (0%)	187 (63.2%) *
Habits of watching online videos $\chi^2 = 50.90$ $p < 0.001$	<15 min	90 (25.9%)	36 (12.2%)
	15 min–1 h	141 (40.6%) *	72 (24.3%)
	1 h–2 h	53 (15.3%)	86 (29.0%)
	>2 h	63 (18.2%)	102 (34.5%) *
Attitudes to science $\chi^2 = 90.55$ $p < 0.001$	Negative	0 (0%)	10 (3.4%)
	Neutral	9 (2.6%)	77 (26.0%)
	Positive	338 (97.4%) *	209 (70.6%) *

Cluster 1 included those participants who were older and well-educated in terms of demographic characteristics, while participants in Cluster 2 were younger and less educated. Specifically, all the participants in Cluster 1 were above 30 years old and with university degrees. By contrast, the majority of participants (69.9%) in Cluster 2 were aged between 18–29 years old. They were also relatively less well-educated: only 36.8% of the respondents in this cluster had university degrees. In addition, Cluster 1 had a balanced sex ratio while Cluster 2 had more females (69.9%) than males.

With respect to habits and attitudes, participants in Cluster 1 generally spent a shorter time watching online videos, with two-thirds of them (66.5%) spending less than one hour per week watching online videos, whereas almost two-thirds of Cluster 2's participants (63.5%) watched online videos for more than one hour per week. Almost all participants (97.4%) in Cluster 1 had positive attitudes towards science, with only 2.6% having a neutral attitude and none having a negative attitude. By contrast, those in Cluster 2 had more varied attitudes towards science: participants with neutral (26.0%) and negative (3.4%) attitudes towards science made up 29.4% of the total sample population within this cluster.

Overall, Cluster 1 can be characterized as mainly older, well-educated participants with a positive attitude towards science and spending less than one hour per week watching online videos. In contrast, Cluster 2 can be characterized as mainly younger, mainly female, less well-educated and with more varied attitudes towards science, who typically spend more than one hour per week watching online videos.

3.2. The Impact of Narrations on Participants in Different Clusters

Results (Table 4) showed that, overall, the participants' perceptions of the importance of climate change for the planet (RQ1) and their own life (RQ2) did not differ significantly between clusters (ANOVA, F = 1.15, $p = 0.28$ for RQ1; F = 0.04, $p = 0.85$ for RQ2). For respondents in Cluster 1, their perceptions were not significantly impacted by the type of

narration used in the video (ANOVA, F = 0.003, $p = 0.96$ for RQ1; F = 2.00, $p = 0.16$ for RQ2). On the other hand, within Cluster 2, participants who watched the infotainment version of the video perceived climate change as a less serious phenomenon for the planet than those who watched the expository version, and this difference was highly significant (ANOVA, F = 9.49, $p = 0.002$ for RQ1). However, regardless of whether viewers in Cluster 2 watched the video with the infotainment version or the expository version, they felt similarly afterwards about the degree to which climate change impacted their own lives (ANOVA, F = 0.001, $p = 0.98$ for RQ2).

Table 4. The influences of narrations on participants' perceptions of RQ1 (Does the video leave you feeling that climate change is a serious issue for the planet?) and RQ2 (Does the video make you feel that climate change has an impact on your own life?) within Cluster 1 and Cluster 2. Answers ranged from 1 to 5. A greater value represents a higher awareness of climate change. * indicates a significant difference ($p < 0.01$) between the infotainment and expository versions.

Cluster	Question	Narration	N	Mean	Std. Deviation
Cluster 1	RQ1	Infotainment	160	4.01	0.789
	RQ1	Expository	183	4.01	0.839
	RQ2	Infotainment	160	3.66	0.898
	RQ2	Expository	184	3.52	0.929
Cluster 2	RQ1	Infotainment	137	3.91 *	0.927
	RQ1	Expository	159	4.23 *	0.826
	RQ2	Infotainment	137	3.60	1.088
	RQ2	Expository	158	3.59	1.041

Taking the characteristics of the clusters into account, we can conclude that in this instance, viewers under 30 years old who typically spend more than one hour per week watching online videos, largely do not have a university degree while holding varied attitudes towards science, and are predominantly female (i.e., Cluster 2) are less likely to regard climate change as a serious issue for the planet after watching the infotainment version than those who watch the expository version. This finding suggests that the influence of an infotainment-style narration upon viewers' general perceptions and attitudes about climate change can vary according to some combination of their age, gender, education, *a priori* attitudes towards science and how long they spend watching online videos. Irrespective of the video narration used, however, viewers from both clusters were less likely to regard climate change as being as significant for their own lives as it is for the planet.

Furthermore, if participants from both clusters are treated together, those viewing the video with the expository narration found the video left them feeling that climate change was a significantly more serious issue for the planet than participants watching the infotainment version, irrespective of their age (two-factor ANOVA (age + version), F = 5.08, $p < 0.05$), education (two-factor ANOVA (education + version), F = 9.12, $p < 0.01$), or gender (two-factor ANOVA (gender + version), F = 4.97, $p < 0.05$). This points to a general advantage of the expository narration compared to the infotainment narration when it comes to persuading viewers of the seriousness of climate change for the planet.

3.3. Cultural Influences: Spanish versus English Speakers

Not all participants in our survey chose to answer the non-mandatory question about their country of residence and neither did we specifically question them about their culture. Nevertheless, for those that declared their country of residence when watching the Spanish ($n = 334$) and English ($n = 306$) versions of the video, 86.8% who watched the Spanish versions were resident in Spain (a high-context country), with a further 9.0% resident in high-context Central and South American countries (El Salvador, Mexico, Brazil, Chile and Argentina), suggesting that almost all participants (over 95%) watching the videos in Spanish were living in high-context countries. By contrast, nearly two-thirds of those

watching the English versions (64.1%) were resident in low-context countries (mainly New Zealand, Netherlands, Australia, USA, Germany and the UK).

Attitudes to science prior to watching the video did not differ significantly for participants taking the survey in English compared to those taking it in Spanish (Chi-square test, $\chi^2 = 8.28$, $p > 0.05$). Likewise, the type of narration used in the video made no significant difference as to how participants, after watching the video, perceived the importance of climate change for their own lives whether they watched the English version (ANOVA, F = 0.63, $p = 0.43$) or the Spanish version (ANOVA, F = 0.28, $p = 0.60$) (Figure 2).

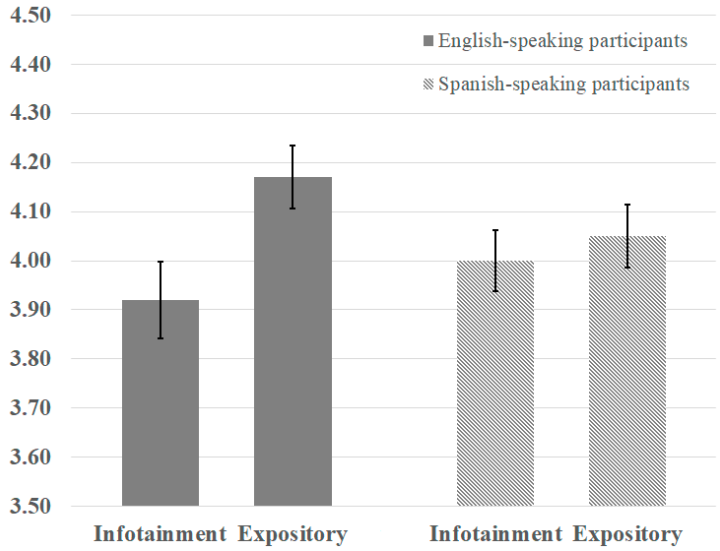

Figure 2. The influence of narration (infotainment or expository) on answers to RQ1 for English-speaking participants and Spanish-speaking participants. A higher score represents a higher concern that climate change is a serious issue for the planet.

For viewers of the Spanish versions, the type of narration made no significant difference as to whether, after watching the video, they thought climate change was a serious issue for the planet (ANOVA, F = 0.27, $p = 0.60$). However, the type of narration had a highly significant effect upon those watching the English versions of the videos as to whether they thought climate change was a serious issue for the planet (ANOVA, F = 6.36, $p = 0.01$). Specifically, the expository version was likely to make English-speaking viewers, who were living predominantly in low-context cultures, think climate change is a more serious issue for the planet (Figure 2).

4. Discussion

Participants in our study who lacked a university degree expressed a preference for the infotainment version and this effect was independent of age [6]. At first glance, then, the use of an infotainment style of narration might seem advantageous for engaging some of the harder to reach groups in society, which often have lower levels of education. However, the findings from this study suggest that the use of an infotainment style risks reducing the perception that climate change is a serious issue for the planet, especially for the part of the audience that included those without a university degree. This "reduction effect" may be a consequence of the entertaining tone being frequently associated with trivial or unimportant topics, whereby framing a topic as infotainment can create in viewers the impression that it is not a very important issue [28] and lead to apathy [75]. Boukes et al. [76] came to a similar conclusion after analyzing social media posts by a wide variety of American TV shows on Facebook, YouTube and Twitter: they found infotainment (satire, in this case) produced more "likes" but less serious engagement with the content than did partisan posts that lacked humor.

Female participants in our study tended to exhibit less skepticism that did males [6]. Given the preponderance of females in Cluster 2, it is possible that some of the difference in the impact of the two narration styles resulted from the partisan-like "voice-of-God" style of the expository narration being more convincing when it came to conveying the seriousness of climate change. Indeed, compared to those in Cluster 1, participants in Cluster 2 were arguably even more positively affected by the expository version in terms of their appreciation of the seriousness of climate change for the planet than they were negatively impacted by the infotainment version (Table 4).

Another interesting finding of this study is that, regardless of the style of narration used for the online video, participants viewed the global risks and seriousness of climate change to be higher than the personal risks or seriousness that climate change represented for them. This is in line with other studies [77]. For example, a survey of German citizens about the risks of flooding—due to an increase in intensity and frequency of heavy precipitation events in Europe as a consequence of climate change—found that personal risk perception was low among the participants while their global risk perception was far higher [78]. In that and many other studies, e.g., [77,79–81], females are more likely to perceive global risks as more serious than are males. This concurs with our finding regarding the response of the female-weighted Cluster 2 to the expository-style narration but, given the relatively dampened response of Cluster 2 to the infotainment version of the video, this further suggests that an infotainment-style narration is not the best vehicle for communication if the goal is to raise awareness of the seriousness of a science subject such as the risks posed by climate change.

In contrast to Cluster 2, participants in Cluster 1 seemed unaffected by the style of the video's narration. Exposure to infotainment in science documentaries has been shown to reduce levels of climate change knowledge in audiences with low scientific literacy but not those with high scientific literacy [82]. Additionally, older people can be more skeptical when it comes to climate change [83]. Given that all members of Cluster 1 had university degrees and were over 30, it is perhaps not surprising that people with a higher level of education and life experiences should be less affected by the style of the video as they are likely to have a stronger basis and predilection to critique scientific issues no matter how they are framed. Age may also play a factor in that Cluster 2 participants were younger and they spent significantly more time watching online videos where the typical age of science YouTubers is under 35 [84]. Hence, they might be more susceptible to influence from their perceived peers [85].

The remarkable degree of similarity in responses to the narrations in the video irrespective of the language used (i.e., Spanish or English) [6] suggests that some of the impact of expository and infotainment narrations on viewers is universal and independent of culture [55]. However, our data suggest that there are also cultural influences at play, with English-speaking participants predominantly from countries with low-context cultures being more likely to consider climate change a serious issue for the planet if they watched the expository version. This outcome is consistent with findings about other forms of online content, such as websites [59] and Instagram [61], where direct means of communication appeal more to those from low-context cultures. Given that we used a proxy for culture (i.e., country of residence) and that classifications of culture based upon nation state or language can be problematic [64], our finding that expository narrations are more effective in low-context cultures is best regarded as indicative until confirmed by further research.

For science communicators, the type of narration should really be dictated by the aim of the communication. If it is to convey information or to engage audiences that have little science education, then an infotainment type narration might be best [6]. However, as shown here, if the purpose is to influence attitudes about science, then an expository-type narration is likely to be best.

5. Conclusions

Infotainment may potentially affect a viewer's perception of videos about science and environmental topics such as climate change. Young viewers without a university degree demonstrably prefer infotainment-style narrations, suggesting that using an infotainment style of narration in online videos may be best when communicating to them about science topics such as climate change. However, we show here that the use of infotainment can lead to a reduced perception of the seriousness of climate change. Conversely, an expository style of narration may heighten perceptions of the seriousness of climate change depending upon cultural influences. Our results suggest, therefore, that the use of infotainment in science communication is a two-edged sword: it may help engage some viewers, but it does so ways that can temper perceptions of seriousness. Based upon this study and our other research [6], we suggest that the use of infotainment should be determined by the aims of the communicators and the nature of the target audience. If the purpose is simply to convey information, then infotainment is likely to be most effective and it has the additional benefit of engaging recipients that lack a university education. However, if the purpose of the communication is to affect attitudes and persuade an audience, especially when trying to convey seriousness, then an expository narration is likely to be most effective.

6. Limitations

There are some considerations about our research that should, themselves, temper the conclusions from this study. On the one hand, while our sample cannot represent the entire population of internet users worldwide, it is a large one that is highly heterogeneous with characteristics that are represented within the potential international audience for online videos and, as such, is sufficiently representative to be a valid sample to evaluate theoretical communication processes [86,87]. On the other hand, however, even though we sampled participants from 46 countries, we did not record socio-economic factors such as income. Additionally, participants in our study without a university degree undoubtedly included those in the process of getting one, as well as those who had never attended university at all or who had no intention or ability to do so. This does not detract from our study's finding that the portion of the audience including those without a university degree that watched the infotainment version of the video perceived climate change to be a less serious problem for the planet than those watching the expository version, but it does suggest that it would be useful to drill down into this grouping to determine in finer detail what the effects of any higher education and income (resources to support access to higher education) might be.

The experimental design of this study was good in that: (i) all variables were kept identical save for the narrations of the videos, (ii) participants were randomly presented with one or other of the two videos and (iii) sample sizes were sufficiently large to conduct meaningful tests. Nevertheless, it is impossible to represent all types of infotainment and expository narrations with a single version of each. Ideally, this study should be repeated using different versions of each narrative style, as well as using different degrees of mixing entertainment with information.

Finally, while we found some evidence that cultural aspects of participants could shape their reactions to the type of narration used in the videos, the effects of culture on communication are likely more complex, subtle and nuanced than was possible to examine here. It is also possible that reflection itself may be influenced by cultural and demographic variables, so that asking participants to reflect on the effect of a video on their attitudes to climate change may have an impact on their responses.

These limitations suggest fruitful new lines for future research.

Author Contributions: Conceptualization, B.L., M.J.B. and L.S.D.; methodology, B.L., M.J.B., L.S.D. and W.F.; software, B.L., L.S.D. and W.F.; validation, B.L., M.J.B. and L.S.D.; formal analysis, L.S.D., B.L. and L.Z.; investigation, B.L., M.J.B. and L.S.D.; resources, L.S.D., B.L. and W.F.; data curation, L.S.D., B.L. and L.Z.; writing—original draft preparation, B.L., M.J.B. and L.S.D.; writing—review

and editing, L.S.D., B.L., M.J.B., L.Z. and W.F.; visualization, L.S.D. and L.Z.; project administration, B.L.; funding acquisition, B.L., M.J.B. and L.S.D. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by Ministerio de Economía y Competitividad, Spain (CSO20132-454301-P), and the Stuart Residence Halls Council, New Zealand.

Institutional Review Board Statement: This research was approved by the Ethics Committee of the University of Navarra (approval #: 2016.126).

Informed Consent Statement: Participants were required to give their consent to participate in this research and to confirm that they were 18 years of age or older. No data were collected that would allow participants to be individually identifiable.

Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available as they are being used as the basis for other publications.

Acknowledgments: We thank the University of Navarra, the University of Otago and the Gulf University for Science and Technology for hosting us together during the conception, implementation and analytical phases of this study, respectively.

Conflicts of Interest: The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript or in the decision to publish the results.

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