The role of entertainment in engagement with climate change

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3 **Abstract**

4 The blending of entertainment and education is often used as a mechanism for
5 communicating science to the general public. Key to dissemination of scientific
6 information is cognitive engagement of the audience with the content. The authors describe
7 a study investigating the relationship between entertaining videos and cognitive
8 engagement of the viewer on a topic associated with climate change. Two identical videos
9 discussing the science of climate change were created, with one video containing additional
10 content that was entertaining and based on popular cultural references. Viewers completed
11 an online survey (n = 472) and the data demonstrated that there was no direct link between
12 presentation of the climate change information in an entertaining video and an individual's
13 level of cognitive engagement with the content. Further, that an indirect link was identified
14 so that perceived entertainment increased cognitive engagement. These findings may be
15 useful for communicators of environmental issues, especially with consideration of the
16 development of the field of edutainment.

17

18 **Key words**

19 climate change, videos, entertainment, engagement

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Introduction

The dissemination of scientific information can be used as a basis to inform the public and influence their life choices (McKinnon et al., 2018). Currently, public awareness of scientific information is limited due to the presentation of science in platforms such as peer-reviewed journals and conferences, which often rely upon highly specialized terminology and jargon (Schafer, 2011). Effective communication of science, in clear and accurate terms, which summarize the key findings of research outcomes and is understandable to the lay public, is therefore required to increase public awareness (Scheufele, 2013). Methods for dissemination of science and scientific information to the general public have incorporated a variety of strategies to engage interest in science (Scheufele, 2013).

Climate change is an important issue, with the impacts of climate change a global challenge (Schmid-Petri et al., 2017). Scepticism towards climate change is present in many societies (Dunlap and McCright, 2008), which has led to people becoming wary of information shared about the climate change. This scepticism has led to the development of questions about how to best to communicate the issues associated with climate change to the public (Moser, 2010). Various methods have been employed, with more recent focus in the area of entertainment has been used to engage the general public in science.

Since the 1990s, there has been the development of entertainment platforms which allow for the use of technology as a way of communicating educational information (Okan, 2003). Various platforms such as films, video, and computer games have been used to present educational and scientific content (Dahlstrom, 2014). This has led to the

development of a genera, edutainment, which relies upon visual material on a narrative format and didactic styles, to engage the learner with the content (Buckingham and Scanlon, 2000). The aim of edutainment is to engage the learner, via their emotions, in an interactive pedagogy, which is centred around “fun” (Buckingham and Scanlon, 2000).

An emerging form of edutainment relies on video games to enhance education (e.g. Cai et al., 2006), and develop cognitive engagement with the topic of interest (e.g. Dickey, 2005; Filsecker and Hickey, 2014). However, Abraham and Jayemanne (2017) commented that there are “very few (video) games telling stories that engage with climate change and the unfolding ecological crisis” (pp 74). These authors further expressed that the majority of video games do not have explicit narratives concerning climate change, but tend to embed messages concerning climate change into the narrative focused on human-environment relationships (Abraham and Jayemanne, 2017). Various other methods have been employed to educate the public about climate change. Seminal work in the area of education of the issues associated with climate change has relied on edutainment presentations to the public on climate science (Flora et al., 2014). Specifically, these studies aim to engage members of the public using presentations that incorporate behavioral intentions and discussion with others/peers on the topic (Flora et al., 2014).

One limitation with these previous studies is that the relationship between entertainment (to educate) and cognitive engagement of the viewer on climate change has not been studied extensively. To answer this, we created two identical videos discussing the science of climate change, with one video containing additional content that has imbedded

edutainment in the form of cultural references. Following the random viewing of either video, subjects' cognitive engagement in the content of the video was assessed, with characteristics such as entertainment, age, education, political identity, or scientific literacy used to predict cognitive engagement with the video content.

Literature Review

Communication of science on climate change

Communication of science has been gaining attention from policy makers, universities and scholars (Royal Society, 2006). This has led to the evolution of models where members of the general public have been encouraged to debate science policy (Bubela et al., 2009). Learning about science can occur via formal or informal means, with informal activities often termed "public awareness of science" (Burns et al., 2003). Increasing amounts of scientific information are being made available for public scrutiny via popular media and the internet.

Emerging data from the scientific community has demonstrated that humans are the primary cause of current climate change (*Intergovernmental Panel on Climate Change* (IPCC), 2014). Public discourse on the issue of climate change, where a variety of factors, not the least of which is an ineffective ability to communicate fundamental climate data to the general public, has contributed to widespread mistrust and misunderstanding of scientists and their research (Somerville and Hassol, 2011). Many have become wary of information shared about climate change, given the complexity of

the phenomenon and the expansion of “fake news” concerning climate change (Cooper, 2011).

A challenge in this space is that science and scientific ideas can be complicated, and communication of these ideas often becomes muddled by discipline-specific jargon and terminology. Communication of science to a general population requires careful attention to language (Brownwell et al., 2013). Ensuring scientific messages about climate change are portrayed using clear, easily understood language, is important for the dissemination of such knowledge to the general public (Besley et al., 2017; Moni et al., 2007). Emerging research has investigated the potential of entertainment to engage the public on scientific issues.

Edutainment

Scientists, educators and policymakers are challenged by effective strategies to engage members of the general public on matters such as climate change. Public concern and interest in climate change peaked in 2007, and has since been declining in interest (Stoutenborough et al., 2014). Key to maintaining interest and motivation is cognitive engagement where engaged individuals are more likely to invest in their learning and embrace the challenge of acquiring new knowledge (Milne and Otieno, 2006). One mode of delivering scientific content to the general public that may increase engagement is through the use of entertainment. Entertainment is recognized as a crucial element of the public sphere that captures the attention of viewers and allows for relationships to be formed (Adam, Allan, and Carter 2013). Although limited, there is some evidence to show

that use of entertainment as a tool for educating the public about climate change may increase engagement with the issue. Bore and Reid (2014) have shown that satire in theatre can “promote active and positive engagement with climate change debates.” Similarly, satirical television talk shows have a small but significant effect on audiences who hold strong pre-existing views, but a stronger effect on those with weaker pre-existing views, and can be an alternative route for reaching otherwise unengaged viewers (Brewer and McKnight 2015). More recent work in this area has relied on edutainment presentations to the public on climate science (Flora et al., 2014), where engagement is developed using presentations that incorporate behavioral intentions and discussion with others/peers on the topic (Flora et al., 2014). However, investigation of the cognitive engagement associated with these presentations on climate change have not been performed.

A blending of entertainment and content, or edutainment (Colace, et. al., 2006), aims to support the transfer of (scientific and complex) knowledge via a variety of media such as multimedia software, internet sites, music, films, video, computer games, and TV programs (Colace et al, 2006). With increasingly fragmented consumption of media, where individuals can choose exactly what they want to watch and when (Prior 2005), and rapidly growing viewership on platforms such as YouTube, Netflix, and Facebook (Molla 2017), it is important that scientific knowledge is accurately disseminated through these modern forms of media.

The present research study aimed to address this gap by investigating the use of entertainment in educational online videos. In addition, as there is currently limited

research on the effect of entertainment on cognitive engagement of scientific knowledge through online video, the second aim was to determine if cognitive engagement on the topic was achieved through the video. Given that YouTube is the leading online video-based social media platform worldwide, and is the most popular mode through which videos are shared on the internet (Anderson and Jiang 2018), this platform was chosen for the present study. Participants were presented with educational videos about climate change that either included small clips from film and television (entertaining) or did not include these clips. For this study, cognitive engagement is defined as the audience's ability to retain information presented in the online video.

Research Questions

The aims of this present research are to:

A1. Characterize the effect of an “edutaining” video about climate change on perceived entertainment.

A2. Characterize the effect of an “edutaining” video about climate change on cognitive engagement.

A3. Identify if age, education, political identity, or scientific literacy predict the engagement of the subjects with the “edutaining” video about climate change.

Methods

The videos

The process for creating the videos involved a broad review of the literature on climate change that was distilled to the most salient and relevant points. A narrative was created from these points and turned into a film script for presenting. The videos were edited to ensure they were standardized, such that the correct structure was consistent across the two videos. The two videos were thus almost identical, except for the manipulation. The first video contained educational content focused on the issue of climate change (<https://www.youtube.com/watch?v=c5juYFrTxJQ&feature=youtu.be>). The second video contained the same educational content, plus five additional entertaining clips from film and television (including politicians and popular movies) relevant to the content (<https://www.youtube.com/watch?v=CjpbZLVVwIA&feature=youtu.be>).

The first entertaining media clip played after the presenter in the video said, “Now, for those of you who choose not to accept the overwhelming evidence for climate change...”. The video clip depicted Matthew McConaughey finishing the sentence with a line from the 1994 movie *Dazed and Confused* – “...it would be a lot cooler if you did”. The second entertaining media clip was an audio track that played while the presenter in the video was depicted doing some quick calculations. The track was a snippet from *Man’s Not Hot* by Big Shaq.. When the presenter finished the calculations, the lyric “quick maths” was played along with the words appearing on the screen. The third entertaining media clip was a three second video clip of Trump during his 2016 presidential campaign claiming “We need some global warming! It’s freezing!” The fourth entertaining media clip was a cut of the presenter of the video making a facetious comment. When discussing sea-level rise, the presenter joked that those living near the coast should say goodbye, and to those who had

never been, "...it's about to get a whole lot easier for you!" The final entertaining media clip was a very short cut of the presenter doing an odd arm action which resembled a 'dab', a style of hip hop dance that has now become popular on the internet. The words 'NOT A DAB' appeared during this action.

These memes (a viral form of internet humor) were chosen for either their relevance to the content or because they were currently trending, or 'viral' on the internet, fostering the greatest chance of being relatable to the viewers.

The survey

The online survey was constructed using the Qualtrics platform (Appendix 1). Firstly, a seven-question indicator test was administered to participants, to measure their current level of science literacy and numeracy as a covariate to control for when ascertaining the impact of the videos on cognitive engagement. The participant's score was a tally of correct answers; no weighting was given to more or less difficult questions. This measure was adapted from the National Science Foundation's Science and Engineering Indicators, as used by Kahan et al. (2012).

After this, participants were randomly assigned to one of two YouTube videos: the entertaining or non-entertaining control video. Immediately after the video, participants were asked to rate how entertaining they perceived the video to be. This measure was embedded among three other measures, including feelings of sadness due to the video, belief of factual integrity of the video, and belief regarding whether the video was talking about a topic focused on the negative impact of humans on climate change.

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206 Cognitive engagement was measured next, with twelve multi-choice or short-response
207 questions directly related to content presented in the video. No questions asked for opinions
208 or views other than verifiable facts that were presented in the video. The participant's score
209 was a tally of correct answers, with no weighting on any answers. This was the only
210 measure not adapted from previous instruments in the literature given that the questions
211 within it pertained to the videos developed specifically for this study.

212

213 The survey also contained filler questions that measured participants' risk perception of
214 the impact of climate change, perceived likelihood of climate change affecting the
215 participant (or their family, their society, and the world), attitudes towards greenhouse gas
216 reduction policies, trust in the science showing that climate change is primarily
217 anthropogenic, and intentions to take personal or political action to reduce climate impacts.

218 The risk perception measure was adapted from Kahan et al. (2012). The same wording was
219 used, but instead of a 10-point scale, we used a four-point scale: 1 no risk, 2 very little risk,
220 3 moderate risk, 4 extreme risk. All other measures were adapted from those used by
221 McCright et al. (2016). These measures were not relevant to the present research question;
222 they were included out of interest, and to mask the purpose of the study.

223 Finally, demographic data was collected to better understand the population of participants,
224 and/or to include as covariates in the main analyses. Demographic data collected were the
225 participants age, gender identity, ethnic identity, education, current employment status,
226 household income, religiosity, and political orientation.

227

228 **Analytical techniques**

229 The data was analyzed using the Statistical Package for the Social Sciences (SPSS).
230 ReMediation analyses were used to assess the impact of the video manipulation on the
231 dependent measures. The video manipulation was coded as a dichotomous variable (0 =
232 entertaining video, 1 = non-entertaining video). These analyses were run with the
233 PROCESS macro using bootstrapping procedures recommended by Hayes (2009), in order
234 to estimate both direct and indirect effects of the videos. Age, education, income, political
235 orientation, and pre-measured science literature and numeracy were included as covariates
236 in all analyses, given they have been demonstrated to influence attitudes, perceptions and
237 beliefs about climate change (e.g. Hamilton, 2011).

238 **Results**

239 **Sample population**

240 The sample size of 472 respondents was 58% female and 91% Caucasian. 59% obtained
241 an education of at least one Bachelor degree or higher. The sample demonstrated a spread
242 of distribution of age, with a mean and median of about 41 and 47 years old respectively.
243 The majority of subjects identified as left-wing (64%), with 13% identified as right wing
244 and the remaining 23% reporting no preference.

245

246 The survey was advertised in an equal number of Facebook groups holding advertised
247 views that were considered left- or right-wing, or having no particular preference. This was
248 achieved by targeting mostly groups with explicit support for a political party or leader,

some pages that represented politically-polarized issues, and a couple pages claiming to be a discussion point inclusive of left, right, and centrist people. No rewards were offered for completing the survey; it was completed of participants' own volition.

The effect of entertainment on cognitive engagement

A mediation analysis tested the effect of type of video on cognitive engagement via level of entertainment (Figure 1). Age, income, education, political identity, and science literacy were controlled for. Participants who viewed the entertaining video reported significantly greater perceived entertainment than participants who viewed the non-entertaining video ($p = 0.002$, coefficient = -0.425). Greater perceived entertainment was, in turn, significantly associated with greater cognitive engagement ($p = 0.038$, coefficient = 0.059). Although no direct effect of video type emerged on cognitive engagement (coefficient = -0.007, 95% CI [-0.1664, 0.1512]), an indirect effect of video type on cognitive engagement emerged through perceived entertainment (coefficient = -0.025, 95% CI [-0.0705, -0.0004]), indicating full mediation. That is, the entertaining video was associated with greater cognitive engagement, through greater perceived entertainment.

The associations between the control variables and both perceived entertainment and cognitive engagement were also observed (Table 1). Income, level of education, and science literacy had no association with perceived entertainment. Age was associated with perceived entertainment, such that younger participants reported greater entertainment overall (coefficient = -0.153, $p = 0.036$). Science literacy was associated with cognitive engagement, such that those with greater science literacy were likely to score higher on cognitive engagement (coefficient = -0.110, $p = 0.002$). Political identity was associated

with both perceived entertainment and cognitive engagement, such that those who identified as more left-wing reported greater entertainment overall (coefficient = -0.145, $p = 0.009$) and lower cognitive engagement overall (coefficient = -0.097, $p = 0.003$).

Discussion

Ensuring that the general public has an adequate understanding of scientific knowledge is essential for the advancement of science as a whole. Communicators must rely on using the most effective methods to get information across. Prior research covers outdated technology like chatrooms, television news, and newspapers (Feldman, Hart 2017; Mubaraka, Rohdeb and Pakulski 2009; Prior 2005). Media consumption via online video is rapidly increasing (Molla 2017), so this research investigated the effect of entertainment in online videos, and whether it can influence an individuals' cognitive engagement on the topic.

This study found that, while there was no direct link between the entertaining video and an individual's level of cognitive engagement, an indirect link was confirmed through their perceived entertainment as a mediator. The entertaining video increased perceived entertainment, and perceived entertainment increased cognitive engagement, independently of political identity, age, and education levels (Hamilton 2011; Rainie et al., 2015). This research can be expanded upon in future to solidify the effect of entertainment in other areas of science communication in order to better our understanding of communication techniques and reach wider audiences.

296

297 The absence of a direct link between the entertaining video and cognitive engagement
298 could be explained by the presence of another mediator that has a negative effect on
299 cognitive engagement. For example, the entertaining video could have been distracting
300 enough to negate the positive effect of entertainment. Further research is needed to
301 investigate the relationship of distraction, or other possible negative mediators. A thorough
302 understanding of positive and negative mediators would enable communicators to create
303 more engaging and effective communication videos. The link between entertainment and
304 cognitive engagement within the topic of climate change may have applications in other
305 areas of science communication; for example, vaccination awareness, astrophysics
306 education, or socioscientific issues. Further research is required to solidify the relevance of
307 this link outside of the context of climate change communications.

308

309 Education and scientific literacy had no association with entertainment. This finding is important
310 because an individual's level of education has only a weak to medium effect on their
311 acceptance of climate change and energy topics (Rainie et al., 2015). Since individuals of
312 most levels of education can be prone to science denial, it is encouraging that the use of
313 entertainment as a tool is effective in reaching individuals of any educational background.
314 The respondents' age was negatively associated with perceived entertainment, which
315 confirms our research aim of addressing younger adults with entertainment. Political
316 identity was also associated with perceived entertainment (with participants identifying as
317 right-wing reporting lower perceived entertainment) and highlights the presence of

cognitive biases that inhibit the individual's ability to accept information from opposing views.

Our study demonstrated that political identity was associated with cognitive engagement. Participants who identified as more left-wing were more cognitively engaged. This either suggests that right-wing participants did not engage with either video as much as left-wing participants, probably due to politically motivated rejection of climate change, or that right-wing participants were already less familiar with the facts on climate change than left-wing participants. Therefore, it was important that we controlled for political orientation, given these effects. This, again, highlights the importance of understanding and breaking down cognitive biases when communicators are attempting to reach an audience with a likely predisposition against the information.

Conclusion

In conclusion, this study demonstrates that an indirect link occurred between the entertaining videos and cognitive engagement, so that perceived entertainment increased cognitive engagement associated with climate change. A strength of this study is that it describes the use of popular culture edutainment, to engage with audiences on the topic of climate change. These findings may be useful for communicators of environmental issues, especially with consideration of the development of the field of edutainment.

Limitations

The present findings should be interpreted in light of the limitations in methodology and design of the study. First, no pre-measure was included to assess prior level of understanding or exposure to climate change information. Thus, some participants may have already known the answers to the post-measure of cognitive engagement. This would have had a negligible impact on the main findings for the video manipulation, however, given that we randomly assigned participants to video type ensuring prior knowledge did not systematically covary with experimental condition. We also administered a pre-measured science literacy and numeracy test to control for prior knowledge in analyses (presumably those higher in science literacy and numeracy would also have more knowledge on climate change).

Another limitation was that, although there were qualitative differences between the entertaining and non-entertaining videos, the differences between the videos were small and took the form of just five short additional entertaining media clips. This was deemed necessary to ensure the videos were similar in length but may have resulted in a weaker effect of the video manipulation. Future research should attempt to create videos that are equivalent in educational content, but more dramatically different in entertaining content for a stronger effect of the video manipulation. The sample was somewhat homogenous, being comprised of mostly Caucasian, college educated, and left-wing women. This limits the generalizability of the findings, and further research in this area should be conducted with more representative samples.

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Table 1 - Mediation analysis with variables predicting perceived entertainment and cognitive engagement

Variable	Perceived entertainment			Cognitive engagement		
	Coeff	SE	p	Coeff	SE	p
Age	-0.153*	0.073	0.036	-0.028	0.043	0.517
Income	0.015	0.042	0.720	-0.014	0.025	0.557
Education	0.020	0.056	0.729	-0.009	0.033	0.785
Political Identity	-0.145*	0.055	0.009	-0.097*	0.033	0.003
Science Literacy	-0.012	0.060	0.834	0.110*	0.035	0.002
Video	-0.425*	0.136	0.002	-0.007	0.080	0.925
Perceived Entertainment				0.059*	0.028	0.038

Note: Coeff = coefficient, SE= standard error, p (p-value).

Figure 1. Mediation model depicting the effect of video on cognitive engagement, through entertainment