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Is climate change a laughing matter?

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ABSTRACT

Recently there has been an increase in scientists, educators, and activists moving into comedy to tell the climate story. Could using humour as an educational method encourage a greater response to the climate crisis? The present research addresses this question by exploring the impact that an environmental-based comedy show had on various learn-ingrelated and emotional outcomes. It was hypothesised first that humour has a positive influence on these outcomes, second, that there is a relationship between fear, hope, and responding to climate change, and third, that age is a significant factor in predicting such variables. Participants watched a recording of a live environmental stand-up comedy show and completed a questionnaire about their experience—all during the first COVID-19 lockdown in 2020. The analyses indicated that even in these unprecedented circumstances, the environmental comedy show provided various learning-related outcomes and emotional outcomes. Further, the results suggested that age somewhat predicts variables related to climate change.

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Climate change; humour; comedy; education; environmental behaviour

Introduction

Organisations such as the Intergovernmental Panel on Climate Change (IPCC) and NASA provide consistent evidence that human activity has warmed the planet (IPCC, 2021; NASA 2020; Roe, Baker, and Herla 2017), and warn that in order to halt climate change, humans must first change their behaviour on a global level (IPCC, 2018). Yet, there has been little success in altering such factors and these behaviours (IPCC, 2018). It is, therefore, imperative to consider alternative forms of communication to engage and empower people in combating the climate crisis. Whilst actions from the Government and National Organisations are needed, as citizens and consumers, our actions do have impact, and it is important to alter our individual behaviour where possible and economical, and work alongside the systemic change that is needed (Kaltenbacher and Drews 2020; UNEP. 2022).

Recently, there has been an increase in individual scientists, educators, and activists moving into stand-up comedy as a method to communicate the climate story; weaving humour throughout the stark educational messaging (Chattoo and Green-Barber; 2018; Pinto, Marçal, and Vaz 2015). Whilst comedy refers to a form of deliberate, public-facing performance, sharing or presentation, which attempts to be humorous (Osnes, Boykoff, and Chandler 2019, p. 226), Green Comedy is comedy which discusses the environment. And yet, the impact of this form of comedy is under researched. Could using humour as a method of education encourage the greater population to respond to the climate crisis?

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Humour in education

Humour refers to everything which is funny (Borum Chattoo 2017), and also as a cognitive factor which can aid social interactions and educational encounters (Gordon and Mayo 2014). Throughout the literature, many studies have found that humour in education improves a breadth of learning outcomes, including greater enjoyment of learning, perceived learning, interest, as well as promoting the creation of new ideas, behaviours, and social bonding (Banas et al. 2011; Boykoff and Osnes 2019).

Furthermore, according to Boykoff and Osnes (2019) adding humour into science education can make learning about topics which are complicated and distant feel more accessible, engaging, and relatable for lay audiences. Humour could also aid climate change education because it improves communication around particularly depressing topics (Boykoff and Osnes 2019; Carter, 2015). Learning about climate change can elicit unwelcomed and distancing emotions such as fear, anger, helplessness, and denial (Moser and Dilling 2004; Ojala 2012a), and by applying humour to the situation, these emotions can be somewhat alleviated (Martin 2007) so that the individual can remain active and responsive.

Additionally, by focusing on humour as part of education, we may be able to access a greater part of the population. For example, whilst young people tend to learn about climate change through formal education, Castell et al. (2014) found that most adults in the United Kingdom reported that they learn about science through media. Using green comedy therefore may allow transformative climate change communication to occur not only in the classroom, but also in other contexts, such as through films, comedy shows, social media, and more.

Examples of green comedy include satirical television shows such as The Daily Show and The Colbert Report (Brewer and McKnight 2015), comedic plays (Bore and Reid 2014), and stand-up comedy (Chattoo and Green-Barber; 2018; Pinto, Marçal, and Vaz 2015). Such platforms may allow individuals to unintentionally learn more about climate change, who otherwise would not have sought to learn more. Despite these arguments, audience responses to climate change-related comedy are not widely researched.

This article refers to *environmental education* as the process that increases an individual's knowledge about the environment and its associated challenges, and enables them to develop the necessary skills, attitudes, and motivations to address these challenges (Gillett 1977). Meanwhile, *climate change education* is a subset of environmental education that focuses on acquiring climate change knowledge and response (UNESCO, 2009).

Additionally, this article also refers to learners broadly as anyone who is learning and acquiring knowledge or skills (Bell and Harris 2013). Learning can vary in formality, delivery style, superficiality, and depth, but ultimately, learning continues all throughout one's lifetime (Prozesky 2000). As such, this article holds that all individuals, regardless of background or expertise, are learners. Subsequently, the benefits of this research apply to everyone, whether they be a scientist, a formal educator, a layperson, and everyone in between. Simultaneously, this study aims to address any *environmental communicators*—anyone who conveys or exchanges environmental-related information, news, emotions, or ideas (Flor 2004; Klöckner 2015).

Rationale

Further research is required to understand the complexity and benefits of using humour as a tool for learning about environmental issues. If humour in forms such as green comedy does in fact provide the positive learning outcomes that humour can elicit, then this may provide further evidence that novel forms of education (e.g. acquiring interest and knowledge through informal ways, such as through satirical tv shows) could become more utilised and widespread. Thus, it could have the potential to educate people and prompt changes in their behaviour.

The present research therefore aims to investigate the impact of green comedy by having a broad population watch a 30-minute green comedy clip and respond to questions regarding their learning experience—including their enjoyment, perceived learning, and how relatable they found the comedian. The primary hypothesis, therefore, is that participants will consider green comedy to be a positive learning experience.

The research will also explore emotional factors which may impact one's pro-environmental behaviour (behaviour which science and society considers as being protective or helpful to the environment Krajhanzl 2010; PEB). Previous literature suggests that emotion plays a significant role in how individuals learn about and respond to climate change (Hicks and Bord 2001; O'Neill and Nicholson-Cole 2009; Stevenson and Peterson 2015).

Therefore, the first sub-hypothesis is that there is a relationship between fear, hope, and response to climate change. Additionally, the literature emphasises that young people struggle more with learning about climate change and that it has a great emotional burden for them (Ojala 2012a; Ojala 2012b). These feelings are so severe that in Australia a study found that 27% of 10–14-year-olds believed that the world may end during their lifetime because of climate change and other global issues (Tucci, Mitchell, and Goddard 2007). However, previous research has rarely compared the beliefs, attitudes, and feelings of people across age. Hence, the second sub-hypothesis is that age will be a significant factor in predicting hope, fear, response to the green comedy video, and other climate-related beliefs.

Literature review

To understand the environmental predicament which has developed, it is first necessary to comprehend why our behaviour led us here. Of course, not all people bear equal responsibility for the present predicament, however, as the species who has caused this issue, this article uses 'we' and 'us' to refer to humanity as a whole. The present literature review aims to briefly explore what limitations prevent individuals from actively responding to climate change, discuss how humour might counter these limitations, and evaluate how green comedy may be utilised to promote transformative climate change education. Although there are many factors which might explain why individuals do not respond to the climate crisis, such as their values, political ideologies, family beliefs and so on (Gifford 2011), perhaps we should be focusing most on aspects we can quickly and effectively change: how we communicate about climate change.

Gifford (2011) argues that one of the biggest barriers in altering climate-related behaviour is that a significant percentage of the population does not have trust in science or scientists. If people consider scientists to be untrustworthy or even unlikeable, they are unlikely to listen to them, and in some circumstances, they will even actively go against what the scientist is putting forward (Gifford 2011). Often this is coupled with political alignment, where political views impact belief and response to both climate change, and the scientists communicating about it (Anderson and Becker 2018; Hmielowski et al. 2014; Lewis et al. 2019).

However, trust in science appears to be somewhat generational: Ojala (2012b) found that young people trust researchers and scientists much more than older adults do. This may partially explain the findings which indicate that age is a predictor of behaviour change brought on by climate change (Hornsey et al. 2016; Lewis et al. 2019; Weber 2016).

The language used by scientists and educators also has a considerable influence on what and how learners respond to information. First, if educators use terminology which is unfamiliar to lay audiences, it may make the audience feel confused or bored, and therefore disconnected from both the speaker and the phenomena discussed (Bruine de Bruin et al. 2021; Salita 2015). Additionally, fear messaging exists in both formal and informal methods of climate change education (e.g. scientific papers, media coverage, climate action groups), and is sometimes used in an attempt to trigger an immediate response from the audience (O'Neill and Nicholson-Cole

2009; Stern 2012). However, although this imagery does keep learners captivated and elicits an *initial* sense of urgency to act, it does very little in motivating long-term PEB (Howell 2011; Lowe et al. 2006; O'Neill and Nicholson-Cole 2009). Worse, researchers such as Moser and Dilling (2004) suggest that fear messaging can evoke denial, anger, defensive behaviours, and cause individuals to further distance themselves from the issue. Therefore, it may be useful to alter how we present climate change information so that we can keep learners hopeful, engaged, and responsive.

Could humour be a solution?

Theories of humour

There are three main theories which explain why we find things funny: superiority theory, incongruity theory, and relief theory (Billig 2005). Superiority theory maintains that people laugh when they feel a sense of superiority over others (Billig 2005; Martin 2007), for example, laughing at someone who is clumsy and slips on a patch of ice. Incongruity theory offers that we find things funny when they are surprising or incongruent with our expectations (Billig 2005; Bangsund, Good, and Kool 2018), such as when a joke has an unexpected punch line. Relief theory explains that humour and laughter are used to release emotions and reduce tension (Freud 1928; Billig 2005; Meyer 2000). For instance, laughter often helps in defusing tense or awkward situations.

Social factors

We like people more if they are funny. We feel more relaxed, less defensive, and by laughing with someone, we experience a perceived social bond (Martin 2007). This may be exemplified in Garner's (2006) study, where University students watched lectures which either did or did not have humour involved. Compared to students in the non-humorous condition, students in the humorous condition had higher opinions of lecturers, felt the lecturers communicated more effectively, and rated the lecturers more positively (Garner 2006).

Billig (2005) elaborates that using humour and laughter can assist in teaching social norms and values. By embarrassing others, we are better able to clarify social norms and ensure that people conform to them, and it can even and support inter-group communication and bonding (Martin 2007; Meyer 2000). However, this may be a negative learning experience for those who are embarrassed, and it may make other learners feel uncomfortable (Bangsund, Good, and Kool 2018). Martin (2007) warns that this kind of humour may divide groups or reinforce prejudice against the person who is part of the group being embarrassed.

Furthermore, humour as a useful learning tool relies on the joke delivery being well received, and if it is not, this may lead the receiving individuals to instead feel disinterested, confused, or alienated (Banas et al. 2011; Riesch 2015; Wanzer et. al, 2010)—therefore, achieving the opposite of the desired effect. Furthermore, some scholars fear that if humour is used excessively, it may undermine the credibility of speakers and make the issue appear less serious (Delaure 2011; Gorham and Christophel 1990**;** Lei, Cohen, and Russler 2010). Yet, others argue that the benefits of humour outweigh the unlikely risk of undermining seriousness (Bangsund, Good, and Kool 2018).

Psychological

Humour also appears to have a variety of benefits for one's mental health (Wanzer et al. 2005; Bangsund, Good, and Kool 2018). For example, Wanzer et al. (2005) surveyed 142 nurses about their coping abilities, job satisfaction, and how they used humour to relieve job tensions. The authors found that the more a nurse used humour, the higher their self-perceived coping efficacy, emotional expressivity, and job satisfaction. Samson and Gross (2012) helped explain these findings,

as they found that positive humour helps regulate negative emotion responses—thus suggesting that using positive emotions such as humour can shape affective responses to negative situations.

Similarly, Strick et al. (2009) used a picture-viewing paradigm to investigate if the cognitive demands used in processing humour can reduce negative emotions. Participants first viewed neutral, mildly negative, and strongly negative pictures, then either a humorous or an equally positive non-humorous stimulus, and at last rated their feelings. When presented with humorous stimuli, participants reported feeling less negative feelings in both kinds of *negative* trials when they were presented with non-humorous, positive stimuli. However, humour did not impact emotion in *neutral* trials. Thus, the authors concluded that humour may attenuate negative emotions because of cognitive distraction. Furthermore, Hoad, Deed, and Lugg (2013) offer that humour can act as an influential variable in learning environments; when students are able to engage with humorous moments during learning, it allows them to increase their emotional engagement with the task or topic, and even influence learning-related interactions (e.g. question asking, group work) between students or students and teachers.

Educational

The social and psychological reasoning for why humour may be a useful communication tool may explain why using humour is useful when teaching. Ziv (1988) was one of the first researchers who attempted to clarify the impact that humour within classroom learning had on academic performance. The author found that pupils who were taught by humour-using instructors did better on tests than those who did not have humour in their lessons. Furthermore, Ziv noted that instructional humour is most useful when it illustrates a concept which has just been taught and is then summarised again after laughter ceases (Ziv 1988). However, implications of Ziv's work are limited, as his methods and analysis were relatively unclear.

In contrast, Machlev et al. (2015) did not observe a relationship between humour and actual learning. However, their analysis found that *relevant humour* (related to the topic at hand) predicted students' verbal relatedness, perceived non-verbal relatedness, interest, affect, and perceived learning. Meanwhile, *non-relevant humour* (e.g. off-topic) predicted students' interest and affect. These learning-related outcomes are still very valuable, as they might promote other learning outcomes and changes in behaviour in the future. For example, Shatz and LoSchiavo (2005) found that in comparison to students who did not experience a humour-enhanced course, students who did experience humour in their learning participated more actively in the course (e.g. they posted more on discussion boards, asked more questions). Moreover, some research suggests that humour might encourage more incidental (or unintentional) learning rather than intentional learning (Dixon et al. 1989; Hauck and Thomas 1972). For instance, the learner might remember the joke around a fact, but not the actual fact itself. However, in this context, where humour is being used to engage with wider populations and build relationships between scientific material and those who might not normally read such material, incidental learning is still valuable. It is arguable that even if the learner only walks away with a sense that the speaker was entertaining or reliable, this is still a step in the right direction for building these relationships and the transfer of information.

Furthermore, Banas et al. (2011) reviewed 40 years of research on humour to clarify the impact of instructional humour. From their meta-analysis they concluded that there is substantial empirical evidence that humour can enhance recall and aid learning, and claimed that above all else, their clearest finding is that 'positive, non-aggressive humour has been associated with a more interesting and relaxed learning environment, higher instructor evaluations, greater perceived motivation to learn, and enjoyment of the course' (p.137). It is also valuable to appreciate that throughout literature—including in the meta-analysis from Banas et al. (2011)—that the positive effects of humour in educational settings usually refer to the positive, non-aggressive humour, rather than *all* kinds of humour.

Hope

Perhaps humour is most valuable in climate change education because it counteracts the feelings of despair and fear which are often evoked. People will not change their behaviour to be pro-environmental if they feel that their actions are meaningless (hopelessness), and that climate change is irreversible (Ojala 2012a). 'Hope' in this setting can therefore be considered as the opposite, where actions do matter, and large-scale change is possible to avert the worst impacts of climate change. Ojala's (2012a) study investigating the relationship between hope and PEB in young people found that *constructive* hope (e.g. through behaviour change, we can reverse climate change) was positively correlated with PEB, however hope based on *denial* (e.g. climate change will not impact us) was negatively correlated with PEB.

Osnes, Boykoff, and Chandler (2019) expanded on this research by adding humour as a variable. They instructed students to create educational humorous skits about climate change and present them to their peers. Comedy helped the students positively process negative emotions regarding climate change and to sustain hope, as well as PEB—in line with previous research (Strick et al. 2009; Samson and Gross 2012. Bangsund, Good, and Kool (2018) explored the same variables in secondary students, and had students create videos for their peers rather than skits. Through qualitative analysis, humour and burden were identified as the two key themes used in the videos. These factors provided links between engagement-related feelings and actions and distancing-related themes and actions. The students affirmed that communication is the biggest obstacle in climate change education, but that using constructive humour such as using humour to critique their own PEB rather than the audience's, humour can enable individuals to positively change their behaviour (Bangsund, Good, and Kool 2018).

Satire

Satire uses humour as a device to challenge ideas, behaviours, individuals, institutions, and more, by encouraging us to laugh at them (Bore and Reid 2014). Therefore, satire can comment on difficult topics whilst entertaining audiences (Bore and Reid 2014) by creating an emotional blend of humour and indignation (Skurka, Niederdeppe, and Nabi 2019). Brewer and McKnight (2015) investigated the extent to which two satirical television programmes, The *Daily Show* and *The Colbert Report*, have influenced viewers' certainty that climate change is occurring. They found that watching the satirical shows could shape a viewer's perception of climate change, however, climate change perceptions were mediated by political alignment. Conservative viewers were less likely to understand the irony of some jokes, and thus, they misperceived the intended meaning. They also noted that although the findings demonstrated that satirical programmes *can* impact viewer's climate change opinions, there is no sign they actually *will*.

LaMarre, Landreville, and Beam (2009) also investigated *The Colbert Report* and how political ideology impacts viewer's perceptions of it. They found that although all political groups equally reported the show as being funny, conservatives were more likely to misinterpret satire for actual beliefs. As a result, a large part of the messaging was lost on them, and the use of satire to constructively discuss world issues was much less effective. These findings suggest that political beliefs may limit the effectiveness of using satire to communicate about world issues such as climate change. Furthermore, these findings also highlight a limitation of satire: satire is a more complex kind of humour, which has prerequisites (e.g. knowledge of the issue, beliefs) for it to be effective.

More recently, Skurka, Niederdeppe, and Nabi (2019) used another late-night satire show, *Jimmy Kimmel Live!*, to explore if satire can minimise the emotional trade-offs that occur when using humour to communicate about climate change. They concluded that under certain conditions, such a platform for delivering climate change education can in fact impact adults' climate change risk perception and behavioural intentions.

Stand-up comedy

This genre of humour is usually defined as when a performer stands on a stage and speaks to the audience with the intention of evoking a response (Pinto, Marçal, and Vaz 2015)—usually laughter—but not always. It is common for the comedian to use Superiority humour towards themselves to self-critique and increase relatability, which allows the comedian to present 'problems as arising from human limitations and mistakes, rather than from inherent evil… the clown is flawed, chastised, but then is able to learn from his or her mistakes; furthermore, we are compelled to recognize some part of that clown in all of us' (Delaure 2011; p.453).

Chattoo and Green-Barber (2018) conducted post-viewing surveys with audience members from two different green comedy shows to see what impact the show had on members' learning, engagement, and enjoyment. The authors found that the audiences learned factual information from the show, perceived the comedians as credible sources of environmental information, and thought the show was entertaining (Chattoo and Green-Barber 2018). Furthermore, the audience members strongly disagreed that the show was too 'preachy and boring', nor that the show was intended to persuade or inform more than entertain. Thus, these findings support the argument that humour may be a highly useful tool for education.

Methods and methodology

Research design and rationale

This study was designed to explore the effects of humour in climate change education among as diverse populations as possible. An online survey was created to primarily quantitatively explore the immediate impact that a stand-up green comedy show has on viewers, and secondarily to qualitatively explore the long-term impact of green comedy.

Participants

The initial participants recruited were contacted through the researchers using Facebook (messaging, posts, and groups) and email. This included through personal accounts and platforms (e.g. personal Facebook timeline), as well as University-related platforms (e.g. through emailing University of Edinburgh cohorts). The multistage technique of 'Snowball sampling' was used, where the initial participants were asked to share the survey with others, with the intention to encourage a larger and more diverse sample. Final participants were 62 individuals in six age brackets with the youngest bracket being 16 and 24 and the oldest being 65 plus, with the mode of participants being between the ages of 16 and 24 (46.77%). 62.90% of the participants identified with their gender as female, 33.87% as male, and 3.23% as a gender not listed. The majority of the participants resided in Europe (67.74%), whilst the rest were from Asia (9.68%), North America (19.35%), and Australia (3.23%). All participants reported that they spoke fluent English.

Procedure

The participants first read and completed the information sheet and consent form (Appendix A). Next, they completed a series of basic demographic questions and baseline questions about their beliefs and feelings towards climate change (Appendix B). They then watched a 30-minute stand-up green comedy show. This study took place during the first of the COVID-19 global lockdowns, and therefore participants watched the video in their own homes. After viewing the clip, they completed a brief questionnaire about their experiences (Appendix C). There was also an optional

follow-up question targeted towards people who had experienced green comedy before. If they chose to participate, they were asked to complete a few open-response questions (Appendix D) about their previous green comedy experience and about the long-term impacts of it.

Materials

Questionnaire

Little research has simultaneously investigated humour, hope, and climate change. As such, there are no scales which survey across these topics. A new scale was therefore created for this study, and asked questions about those three areas, as well as belief in climate change, fear, denial, PEB, and learning. The questionnaire also included the option for people to share their previous experiences of green comedy, if applicable.

The green comedy show

The video used was a 30-minute YouTube clip from Dr. Matt Winning's show called 'Climate Strange' (2019). Winning is both an Environmental Economist and stand-up comedian, and in his shows, he aims to synthesise the two in an attempt to make environmental education more enjoyable, accessible, and engaging. Winning consented to his work being used within this study.

Climate Strange involves stand-up comedy; however, it largely functions as a comedy lecture. Accompanied by a PowerPoint slideshow, Winning introduces himself and the topic of climate change, then discusses what human behaviours cause climate change, and how we can change them. Jokes are woven into the factual environmental information seamlessly throughout the show and balance out the presentation of factual information to ensure that the atmosphere is light and entertaining.

Winning uses all three kinds of humour that Billig detailed (2005): superiority, incongruity, and relief. Yet, he uses them in ways which are personalised to him. When he uses superiority humour, he is self-deprecating and pokes fun at himself. For example, when he explains his research, he adds 'or as my dad likes to say, "Matthew's 33 and still at university"'. Winning also navigates through a variety of topics around climate change, paired with a variety of jokes, to the extent to which some jokes are slightly unexpected. By doing so, he is utilising incongruity humour, and this variety keeps the audience engaged. For instance, amongst sharing factual information, he uses jokes about the films Jurassic Park and Titanic, music, suggesting that he is Jesus, and more. He also uses relief humour by means of making jokes about climate change such as joking that when the average globe's surface temperature increases, England will be as warm as France, and worse, that Scotland will be like England. Given the topic at hand, it is arguable that the entire show functions as relief humour.

Winning also uses a narrative-style structure to his show, where he shares that his PEB is partially so that he can justify the carbon footprint of having a child. He explores the different human activities which are most responsible for climate change, and how we can change our behaviour on a personal level. By doing so, the show is in line with previous findings which suggest that using a humorous narrative whilst learning about stressful things can lessen negative emotions and affects (Lefcourt and Martin 1986; Martin and Lefcourt 1983). Additionally, he makes climate change feel less distant, and more like a problem which we can fix if we all exercise PEB. Using a narrative also allows Winning to be seen as a relatable individual who is dealing with the same environmental and emotional issues as everyone else. According to Delaure (2011), this kind of humorous narrative allows the audience to empathise more with the comic (Winning), and so when we see the comic discuss their own limitations and struggles, we are able to better reflect upon ourselves and our own flaws (Delaure 2011). Such attributes could be greatly beneficial in building a relationship with the audience where the speaker—and in this case, a scientist—is considered trustworthy and reliable.

Ethical considerations

Although there is negligible risk associated with participating in the experiment, as with all research, the present study poses some ethical considerations. First, humour is subjective, and can have negative effects if the participant feels that a joke is inappropriate, or if they do not fully understand the joke. Second, humour may make serious issues seem like they are not as severe, therefore, this may lead the audience to take the issues discussed less seriously (Bangsund, Good, and Kool 2018). Third, learning about climate change may evoke eco-anxiety, which may cause some discomfort. However, the intention of the research is to prevent this through humour; so this should not be highly problematic. Nevertheless, this was mentioned in the information and consent forms (Appendix A). At last, the show that the participants watched was rated for ages 16 and over. Therefore, as 16 was the minimum age for individuals to participate in the study, they did not need to obtain parental permission, which is in line with the BERA guidelines.

Analysis

Data management and statistical approach

Quantitative

All analyses were completed using SPSS (IBM Corp 2017). Several measures were taken to prepare the data to ensure that it met the appropriate assumptions. The online questionnaire collected 92 responses, however due to technical issues (e.g. participants starting the survey but not completing it) and occasional spamming, 30 were removed from the dataset, resulting in 62 participants. The five-point Likert-scale survey responses (Appendixes B and C) were given numerical values, with 1 being 'strongly disagree' and 5 being 'strongly agree'. Furthermore, one item was reverse coded to ensure that the scale measured all variables were measuring the variables so that a high value indicated high reflection of such variable.

An alpha level of 0.05 was used to test the hypotheses and assess significance. A sample size of 49 or larger was required to ensure a power of 0.95 (G*Power; Faul et al. 2007). This requirement was met, as 62 participants were included in the analyses. Due to the data being survey generated, descriptive statistics were used to describe tendencies, Pearson's Chi-Square was used to test for variable independence, Spearman's Rank-Order Correlation (rho) was used to explore the strength and direction of relationships between variables, and a one-way analysis of variance (ANOVA) was used to show how group means differed (e.g. younger participants versus older participants).

The hypotheses were each given a number and were discussed throughout both the quantitative and qualitative analyses. These were

1. Participants will consider green comedy to be a positive learning experience.
2. There is a relationship between fear, hope, and responding to climate change.
3. Age will be a significant factor in predicting climate change awareness, hope, and fear.

Qualitative

The qualitative research methods were utilised to help identify trends, provide detail, and to support the quantitative responses. The qualitative data also aimed to gather broader information around green comedy, and to provide more longitudinal data, as the questions asked about previous experiences of green comedy and the impacts they have had on the participants since then.

Quantitative analysis

Baseline questions

The initial baseline questions gave a brief overview of the participant's feelings towards climate change. Descriptive statistics (Table 1) showed that the participants reported high reported knowledge of climate change ($M = 4.22$, $SD = 0.72$), fear ($M = 4.16$, $SD = 0.84$), and relatively high PEB ($M = 3.66$, $SD = 0.72$), meanwhile hope ($M = 2.55$, $SD = 1.10$) was moderate, and hope based on denial (Ojala 2012a) was low ($M = 1.42$, $SD = 0.71$).

The baseline questions also assisted in addressing hypotheses 2 and 3. Spearman's Rho (Table 2) indicated that fear and hope were moderately negatively correlated and statistically significant ($r_s = -.459$, $p < .001$). Fear and belief in climate change were moderately positively correlated and statistically significant ($r_s = -.497$, $p < .001$), as was fear and perceived knowledge of climate change ($r_s = -.473$, $p < .001$). Additionally, perceived PEB and fear were also weakly correlated and significant ($r_s = -.351$, $p = .005$).

Pearson's Chi-Square tests were used to investigate if hope, fear, and climate change awareness differ based on age. The Chi-Square test found that there was a significant relationship between age and belief in climate change (X^2 (15, $N = 62$) = 33.98, $p = .003$). However, there was no significant association observed between age and hope (X^2 (20, $N = 62$) = 21.87, $p = 0.348$) or age and fear (X^2 (35, $N = 62$) = 33.807, $p = .526$).

Analysis of variance (ANOVA) was also used to further examine the relationship between the variables, where the Likert-scale of 1–5 was treated as continuous data rather than interval (Boone and Boone 2012). A one-way ANOVA found that the effect of perceived knowledge of climate change was significant on perceived PEB (F (3, 58) = 5.476, $p = .002$), fear of climate change ($F(3, 58) = 6.631$, $p = 0.001$), and worry about climate change ($F(3, 58) = 8.391$, $p < .000$). Similarly, there was a significant effect of belief in climate change on fear ($F(4, 57) = 10.078$, $p < .000$) and hope ($F(4, 57) = 10.983$, $p < .000$). Furthermore, worry of climate change had a significant effect on perceived PEB ($F(4, 57) = 10.779$, $p < .000$), fear ($F(4, 57) = 10.078$, $p < .000$), and hope ($F(4, 57) = 3.878$, $p = .007$.

Post-viewing statistics

Factor analysis

Twelve questions relating to green comedy and climate change beliefs were factor analysed using exploratory factor analysis with Varimax (orthogonal) rotation (Table 3). The analysis yielded two factors explaining a total of 68.54% of the variance of the entire set of variables.

Table 1. Descriptive statistics for baseline questions.

Item	N	Minimum	Maximum	Mean	Std. Deviation
I believe in climate change	62	1	5	4.74	.828
I consider myself as someone who is knowledgeable about climate change	62	2	5	4.11	.727
I consider myself as someone who does a lot for the environment	62	2	5	3.66	.723
When I hear about the impact of climate change, I feel fearful	62	1	5	4.00	.975
I am very worried about climate change	62	1	5	4.34	.922
I think climate change issues will work themselves out	62	1	4	1.42	.714
When I hear about the impact of climate change, I feel disconnected from it	62	1	5	2.35	1.103
When I hear about the impact of climate change, I feel hopeless	62	1	5	2.55	1.155
Valid N (listwise)	62				

Table 2. Spearman's Rho of baseline questions.

		I believe in climate change	I consider myself as someone who is knowledgeable about climate change	I consider myself as someone who does a lot for the environment	When I hear about the impact of climate change, I feel fearful	I am very worried about climate change	I think climate change issues will work themselves out	When I hear about the impact of climate change, I feel disconnected from it	When I hear about the impact of climate change, I feel hopeless
I believe in climate change	Correlation Coefficient	1.000	.222	.185	.396**	.466**	-.509**	-.258*	-.211
	Sig. (2-tailed)	.	.083	.149	.001	.000	.000	.043	.099
	N	62	62	62	62	62	62	62	62
I consider myself as someone who is knowledgeable about climate change	Correlation Coefficient	.222	1.000	.435**	.401**	.481**	-.203	-.258*	-.308*
	Sig. (2-tailed)	.083	.	.000	.001	.000	.114	.043	.015
	N	62	62	62	62	62	62	62	62
I consider myself as someone who does a lot for the environment	Correlation Coefficient	.185	.435**	1.000	.311*	.357**	-.036	-.042	-.174
	Sig. (2-tailed)	.149	.000	.	.014	.004	.782	.746	.176
	N	62	62	62	62	62	62	62	62
When I hear about the impact of climate change, I feel fearful	Correlation Coefficient	.396**	.401**	.311*	1.000	.532**	-.529**	-.113	-.468**
	Sig. (2-tailed)	.001	.001	.014	.	.000	.000	.383	.000
	N	62	62	62	62	62	62	62	62
I am very worried about climate change	Correlation Coefficient	.466**	.481**	.357**	.532**	1.000	-.456**	-.400**	-.373**
	Sig. (2-tailed)	.000	.000	.004	.000	.	.000	.001	.003
	N	62	62	62	62	62	62	62	62
I think climate change issues will work themselves out	Correlation Coefficient	-.509**	-.203	-.036	-.529**	-.456**	1.000	.289*	.304*
	Sig. (2-tailed)	.000	.114	.782	.000	.000	.	.023	.016
	N	62	62	62	62	62	62	62	62
When I hear about the impact of climate change, I feel disconnected from it	Correlation Coefficient	-.258*	-.258*	-.042	-.113	-.400**	.289*	1.000	.029
	Sig. (2-tailed)	.043	.043	.746	.383	.001	.023	.	.821
	N	62	62	62	62	62	62	62	62
When I hear about the impact of climate change, I feel hopeless	Correlation Coefficient	-.211	-.308*	-.174	-.468**	-.373**	.304*	.029	1.000
	Sig. (2-tailed)	.099	.015	.176	.000	.003	.016	.821	.
	N	62	62	62	62	62	62	62	62

**Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

Table 3. Rotated component matrix table SPSS output.

	Component	
Item	1	2
The show was entertaining	.873	
The jokes were appropriate	.863	
The comedian was relatable	.860	
The show was educational	.858	
The information about climate change was easy to understand	.769	
I would watch green comedy again	.740	
The information and the comedian were reliable	.738	
I learnt something from the show	.695	.400
After watching the show, I am more likely to make changes in my life	.676	.402
The show enabled me to reflect on my own environmental behaviour	.553	.488
After watching the show, I feel less fearful		.875
After watching the show, I feel more hopeful		.844
Eigenvalue	6.82	1.39
% of Total Variance	56.89	11.65
Total Variance		68.54

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 3 iterations.

Table 4. Descriptive statistics of Factor 1.

Item	N	Minimum	Maximum	Mean	Std. deviation
The show was entertaining	62	1	5	4.27	.813
The jokes were appropriate	62	1	5	4.23	.688
The comedian was relatable	62	1	5	4.27	.833
The information and the comedian were reliable	62	1	5	4.08	.946
The show was educational	62	1	5	4.18	.779
I learnt something from the show	62	1	5	3.79	.832
I would watch green comedy again	62	1	5	4.03	1.040
The information about climate change was easy to understand	62	1	5	4.26	.788
Valid N (listwise)	62				

Factor 1 one appears to reflect learning-related outcomes and emotional responses, and therefore addresses hypothesis 1 (learning-related outcomes). Factor 1 also shared two cross loadings with Factor 2, which tapped show-provoked PEB. Therefore, these were included in Factor 1, and Factor 1 explained 56.89% of the overall variance.

Factor 2 explained 11.65% of the overall variance and consisted of items tapping hope, and fear (full list seen in Table 5). These therefore reflect emotional responses, and thus Factor 2 addressed Hypothesis 2 (emotional response). Given that these two factors appear to address hypotheses 1 and 2, it is also useful to group the two when broadly discussing the statistics for the hypotheses. As such, they will partially be analysed as factors, and be loosely referred to as Factor 1 and Factor 2.

Factor 1

For Factor and Hypothesis 1, eight items were explored. Descriptive statistics (Table 4) were used to evaluate if the participants considered the green comedy to be a positive learning experience. The means of all the items were quite high, averaging at a mean of 4.14.

Spearman's Rho also indicated that all of the items were at least moderately positively correlated (Table 6), with many of the items being strongly positively correlated. This is unsurprising, as we would expect that those who find the jokes appropriate would also find the show entertaining (r_s= .762, p < .001), and we would assume that those who find the show to be educational would also report learning something from the show (r_s= .605, p < .001).

Table 5. Descriptive statistics for Factor 2.

Item	N	Minimum	Maximum	Mean	Std. deviation
After watching the show, I feel less fearful	62	1	5	2.66	.904
After watching the show, I feel more hopeful	62	1	5	2.90	.970
The show enabled me to reflect on my own environmental behaviour	62	1	5	3.74	.957
After watching the show, I am more likely to make changes in my life	62	1	5	3.35	.977
Valid N (listwise)	62				

Factor 2

For Factor and Hypothesis 2, four items were tapped. Descriptive statistics (Table 5) showed that on average, viewers reported feelings as being somewhat more hopeful ($M = 2.66$, $SD = .904$) and somewhat less fearful ($M = 2.90$, $SD = .970$) after watching the green comedy. Furthermore, on average, participants felt that they were moderately likely to make changes in their own lives ($M = 3.35$, $SD = .977$) and reflect more on their PEB ($M = 3.74$, $SD = .957$) after watching the show.

Spearman's Rho again was used to investigate if there was a relationship between the variables (Table 7), all of which were at least weakly positively correlated. The analyses showed that hope and lack of fear were significantly correlated ($r_s = .604$, $p < .001$), indicating that there is a clear relationship between the two, where the more hopeful one is, the less fearful they are. Additionally, reflection of PEB and likelihood to change behaviour after watching the show were positively and significantly correlated ($r_s = .624$, $p < .001$). Hope was also significant and moderately positively correlated with reflection of PEB ($r_s = .457$, $p < .001$) and likeliness to change behaviour after watching the show ($r_s = .494$, $p < .001$), suggesting that hope may impact PEB.

Reliability

Cronbach's Alpha was used to evaluate the post-viewing questionnaire's internal consistency and reliability. All items were found to have high levels of internal consistency, as shown in Table 8 below. Thus, the items were all theoretically accurately measuring the variable intended.

Qualitative analysis

Of the 62 participants, 5 had experienced green comedy before and shared their experiences of it. These participants primarily reported watching satirical TV shows and documentaries, and stand-up comedy. In response to 'Did you find it informative? If so, how did the comedian/educator achieve this?', two elaborated that the green comedy was educational and effective by combining '*comedy, hard hitting facts, [and] silly comparisons*', keeping the information '*light and funny*'. Additionally, other participants explained that comedy connected the speakers and the audiences, in a way which made learning more accessible:

> *'Self-ironic, caricaturing both opponents and supporters, taking a radically different perspective that wasn't pointing a finger at the audience individually but was nonetheless relatable and showed the relevance of the topic'*

> *'these sort of shows are an innovative way to educate people about the key issues, they are much more light hearted and wider reaching than a talk or conference by a leading scientist or organisation'*

Meanwhile, one participant detailed that the learning experience was effective because it was from a source that they trusted. It is deducible that it was the combination of comedy and source reliability which made this an effective learning experience for the participant.

When asked 'What impact do you think it had on you then, now, and why?', the majority of the participants detailed a variety of positive outcomes, such as increased knowledge, and

Table 6. Spearman's Rho of Factor 1.

		The show was entertaining	The jokes were appropriate	The comedian was relatable	The information and the comedian were reliable	The show was educational	I learnt something from the show	I would watch green comedy again	The information about climate change was easy to understand
The show was entertaining	Correlation Coefficient	1.000	.762**	.671**	.548*	.646**	.526**	.505**	.449**
	Sig. (2-tailed)	.	.000	.000	.000	.000	.000	.000	.000
	N	62	62	62	62	62	62	62	62
The jokes were appropriate	Correlation Coefficient	.762**	1.000	.702**	.645**	.639**	.485**	.493**	.623**
	Sig. (2-tailed)	.000	.	.000	.000	.000	.000	.000	.000
	N	62	62	62	62	62	62	62	62
The comedian was relatable	Correlation Coefficient	.671**	.702**	1.000	.515**	.531**	.454**	.633**	.514**
	Sig. (2-tailed)	.000	.000	.	.000	.000	.000	.000	.000
	N	62	62	62	62	62	62	62	62
The information and the comedian were reliable	Correlation Coefficient	.548**	.645**	.515**	1.000	.663**	.489**	.516**	.427**
	Sig. (2-tailed)	.000	.000	.000	.	.000	.000	.000	.001
	N	62	62	62	62	62	62	62	62
The show was educational	Correlation Coefficient	.646**	.639**	.531**	.663**	1.000	.605**	.414**	.537**
	Sig. (2-tailed)	.000	.000	.000	.000	.	.000	.001	.000
	N	62	62	62	62	62	62	62	62
I learnt something from the show	Correlation Coefficient	.526**	.485**	.454**	.489**	.605**	1.000	.368**	.333**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.	.003	.008
	N	62	62	62	62	62	62	62	62
I would watch green comedy again	Correlation Coefficient	.505**	.493**	.633**	.516**	.414**	.368**	1.000	.555**
	Sig. (2-tailed)	.000	.000	.000	.000	.001	.003	.	.000
	N	62	62	62	62	62	62	62	62
The information about climate change was easy to understand	Correlation Coefficient	.449**	.623**	.514**	.427**	.537**	.333**	.555**	1.000
	Sig. (2-tailed)	.000	.000	.000	.001	.000	.008	.000	.
	N	62	62	62	62	62	62	62	62

Table 7. Spearman's Rho of Factor 2.

		After watching the show, I feel less fearful	After watching the show, I feel more hopeful	The show enabled me to reflect on my own environmental behaviour	After watching the show, I am more likely to make changes in my life
After watching the show, I feel less fearful	Correlation Coefficient	1.000	.604**	.296*	.223
	Sig. (2-tailed)	.	.000	.019	.082
	N	62	62	62	62
After watching the show, I feel more hopeful	Correlation Coefficient	.604**	1.000	.457**	.494**
	Sig. (2-tailed)	.000	.	.000	.000
	N	62	62	62	62
The show enabled me to reflect on my own environmental behaviour	Correlation Coefficient	.296*	.457**	1.000	.
	Sig. (2-tailed)	.019	.000	.	.000
	N	62	62	62	62
After watching the show, I am more likely to make changes in my life	Correlation Coefficient	.223	.494**	.624**	1.000
	Sig. (2-tailed)	.082	.000	.000	.
	N	62	62	62	62

**Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

Table 8. Cronbach's Alpha reliability results for Factors 1 and 2.

	Scale mean if item deleted	Scale variance if item deleted	Corrected item-total correlation	Squared multiple correlation	Cronbach's alpha if item deleted
The show was entertaining	41.50	50.910	.787	.832	.912
The jokes were appropriate	41.55	52.547	.771	.809	.914
The comedian was relatable	41.50	50.549	.798	.796	.912
The information and the comedian were reliable	41.69	50.314	.707	.669	.915
The show was educational	41.60	51.261	.792	.807	.912
I learnt something from the show	41.98	51.131	.746	.657	.914
I would watch green comedy again	41.74	49.113	.721	.690	.915
The information about climate change was easy to understand	41.52	52.713	.644	.658	.918
After watching the show, I feel less fearful	43.11	55.053	.360	.465	.929
After watching the show, I feel more hopeful	42.87	52.278	.533	.548	.923
The show enabled me to reflect on my own environmental behaviour	42.03	50.851	.655	.635	.917
After watching the show, I am more likely to make changes in my life	42.42	49.657	.733	.683	.914

even PEB. For example, one participant reported that watching satirical TV shows discussing climate change encouraged them to eat less meat and improve their recycling and reusing practices.

Multiple participants expressed that not only do they feel climate change communication tends to feel depressing but also that humour can help combat this and make discussing climate change less burdening. For example, '*It helps to have it presented in a humorous way as it is quite serious. So much of news is sad and dramatic, so to have it funny and dramatic is a nice change*'. These findings support the theories that humour can be particularly useful in discussing distressing topics, as they alleviate some of the emotional burden and fatigue (Bangsund, Good, and Kool 2018).

Discussion

Hypothesis 1

First, the results confirmed that participants considered the green comedy video as a positive learning experience. On a scale of 1 to 5, with 5 being strongly agree, the average participant reported above 4 for all the learning-related outcomes. While this does not necessarily result in improved learning, this finding is valuable, as these results confirm that communication methods like green comedy can be informative and used to educate about climate change. Further research here would be beneficial to clarify whether learning is also improved from these positive experiences.

Spearman's Rho showed that all the outcomes were correlated—many of them significantly and positively—which supports not only Hypothesis 1 but also previous literature. Some notable correlations included the significant positive correlations between finding the show entertaining and: the speaker and information reliable; educational; being likely to watch green comedy again; and most strongly, the jokes being appropriate. These results support previous findings which have posited that humour comedy can deliver educational material (e.g. Banas et al. 2011; Chattoo and Green-Barber 2018; Shatz and LoSchiavo 2005; Ziv 1988), and that appropriateness of jokes is crucial to ensuring that humour is a positive element in a learning experience (Wanzer, Frymier, and Irwin 2010).

Additionally, Spearman's Rho suggested that the more an individual felt the comedian was relatable, the more they found the jokes to be appropriate. When examining the variables that correlated with likeliness to watch green comedy again, the variable which was most strongly positively correlated was how relatable the comedian was. This reaffirms that relatability to the communicator is important when learning about scientific matters (Castell et al. 2014), and that relevant humour can predict learning-related outcomes (Machlev et al. 2015). Moreover, these findings may be useful in solving current communication issues as identified by Castell et al. (2014) where lay people feel little trust and connection to scientists.

The qualitative data also supported these findings, as several participants detailed that comedy was useful for education and bridging the communities of academia. This supports theories by Bangsund, Good, and Kool (2018) and Bore and Reid (2014), who have explained that such styles of humour allow for the audience to reflect on their own behaviour without feeling attacked. Participants also appreciated that using humour to convey climate change education is effective because it combines comedy with factual information and that such platforms have the potential to be '*innovative way[s] to educate people about the key issues*' and be wider reaching than formal education methods.

Hypothesis 2

The analyses also supported the second hypotheses, that there is a relationship between fear, hope, and responding to climate change. In both the baseline questions and post-viewing questions, there were significant negative correlations between fear and hope, indicating that the more fearful one was, the less hopeful (or more hopeless) they were. Both findings are in line with previous research such as Ojala (2012a; 2015). Furthermore, there was a significant positive relationship between fear and belief in climate change, as well as fear and perceived knowledge of climate change. The ANOVA results also confirmed these relationships, as they showed that perceived knowledge of climate change and belief in climate change both had a significant effect on fear. These relationships are understandable; the more aware we are of a danger, the more we are going to fear it. Furthermore, many participants reported that watching the green comedy made them feel slightly more hopeful and less fearful; Spearman's Rho revealed that hope and fear (or lack of) were positively correlated in the post-viewing analyses, where the more hopeful someone felt, the less fearful they felt.

Hypothesis 3

The analyses partially supported the third hypothesis, as they suggested that age was a predictor of *some* variables, but not others. In line with the limited amount of previous research that exists (Hornsey et al. 2016; Lewis et al. 2019; Weber 2016), the present study found that age did significantly predict belief in climate change, where younger participants were more likely to believe in climate change than older participants. However, there was no significant relationship between age and fear or hope. Yet, the participants' ages were not normally distributed, as the cumulative percentage of participants under the age of 35 years was 77.42%. Therefore, it would be valuable for future research to use a more balanced sample of ages.

Additional outcomes

The results also explored potential PEB. Analysis of the baseline questions showed that there was a weak significant correlation between intention to undertake PEB and fear, and the ANOVA also showed that there were relationships between PEB, fear, knowledge of climate change, and belief in climate change. This is understandable, as fear can promote *some* motivation to change behaviour, however, a large body of previous research warns that fear can also prompt inactivity (O'Neill and Nicholson-Cole 2009; Stevenson and Peterson 2015). Perhaps a 'healthy' amount of fear is needed—enough to cause concern—but not so much so that it becomes detrimental. Moreover, the post-viewing items showed that on average, participants felt that after watching the show, they were moderately more likely to reflect on their own PEB and make changes in their lives. If possible, future research would follow up to see if these were in fact carried out. Furthermore, some participants who supplied qualitative data detailed that the green comedy they previously experienced influenced their long-term PEB. In combination, these results hold promising implications that green comedy could prompt viewers to reflect and increase their PEB.

General limitations

First, future research in this nature should have more diligent and robust methodology. In this study two different surveys were administered: one before the video to establish baseline beliefs, and after the video to explore the response to the green comedy. This decision was made because the follow-up survey questions would not fully be suitable to ask pre-watching, as they were all based on the experience. However, to reliably assess the effect of the video, the same questionnaire should have been applied before and after the video. Consequently, it may be difficult to conclude what the exact impact of humour was in the present study. Furthermore, it also would have been beneficial to create two conditions, one where humour was used, and one without. Comparison between these groups would allow for the impacts of humour to be measured more clearly. Therefore, future research should use such methods in order to yield more significant results.

It would also be useful for future research to explore alternative measures of variable measurement. Likert scales are extremely useful for gathering survey data; however, they are subjective, as individuals' perceptions of 'strongly agree' may differ from person to person (Neuman 2014). Additionally, due to the novelty of this topic, no scales have yet combined all the variables intended to be measured; therefore, the scale was designed for this study. Whilst this was useful as it measured all the variables, and the internal consistency was high, the limitation is that the scale had not been piloted or replicated before. It may therefore be useful for future research to modify the present questionnaire, replicate this study, or to at least conduct a pilot study.

Additionally, to obtain globally generalisable results, future research should ensure that the participants' demographics are more evenly dispersed, as the sample was heavily weighted towards young European women—three demographics which are significant predictors of

climate change belief and PEB (McCright 2010; Stevenson and Peterson 2015). Though the sample met the requirements to be statistically significant (G*Power; Faul et al. 2007), for globally generalisable findings, this sample needs to be larger, and more representative of the global population.

And although the phenomenon of humour is universal, it is also culturally tinted (Jiang, Li, and Hou 2019). Therefore, the kind of humour, when it is used, and the value it has, can all vary by culture and situation. Some research has been conducted to investigate if humour can be used in education cross-culturally (e.g. Sambrani et al. 2014), and indeed suggested that it can be. However, further research should be done to explore cultural differences in this area, and also to examine the differences across cultures in other notable areas, such as trust in science. Additionally, if snowball sampling is to be used again in the future, to ensure a more diverse and unbiased sample, care should be taken to start the snowballing from several very different individuals in order to reach bigger and border networks (Kirchherr and Charles 2018).

It is also important to note that due to the nature of the survey research, all questions are self-reported. Social desirability is an issue within all kinds of research involving self-reporting, and this is also true regarding self-reported PEB, where authors such as Chao and Lam (2011) have observed that individuals tend to report themselves as having higher PEB than other observers report. Likewise, it is possible that this extends to variables like hope, fear, and PEB (e.g. the socially desirable thing would be to report being fearful of climate change). Furthermore, this study took place during the first of the global COVID-19 lockdowns, therefore it is possible that the conditions that the participants completed the experiment in may have been variable (e.g. interruptions due to home-schooling).

Implications

Despite the limitations, the present research is a unique and valuable addition to the existing research indicating that humour is a useful tool for environmental and climate change education. Even through watching pre-recorded videos at home during a pandemic, the present results support the theories and previous literature which suggest that humour can provide positive learning-related outcomes and that emotions are involved in responding to climate change. In addition to the advisories for future research regarding adapting the present study (or similar), to best understand this phenomenon, it would be beneficial for researchers to expand upon this topic and explore humour in environmental education across different media, in different forms (e.g. relief-theory style versus superiority), and to observe the affects that they can have on learning outcomes, emotion, and long-term PEB.

The findings of the present and future research may be useful for those working in education, communication, policymaking, and more; humour could be used in a plethora of platforms, from classroom learning to government advertising. Ultimately, it may have the power to educate the wider population, encourage understanding of, and potential motivation towards, improved PEB, and address the climate crisis.

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APPENDIX A - Information sheet and consent form

Information sheet

Participant information sheet

You are being invited to take part in research on how comedy can be used in environmental education. Emma Carroll-Monteil is leading this research as part of her MSc in Outdoor Environmental and Sustainability Education. Before you decide to take part, it is important you understand why the research is being conducted and what it will involve. Please take time to read the following information carefully.

What is the research about?

The present research investigates if and how comedy can be useful for environmental education. It will investigate how comedy can educate the public about particularly serious topics, such as climate change. This will be explored by having participants watch a clip of 'Green Comedy'—part of a comedy show which involves environmental topics.

Why have I been invited to take part?

The present research aims to survey as much of the population as possible.

Do I need to take part?

Your participation in this study is entirely voluntary. If you wish to withdraw, you can do so at any time without providing any reason. If you withdraw then we will give you the opportunity to have any data already collected destroyed.

What will I be asked to do?

If you agree to take part then you will watch a video clip of Green Comedy, and then fill in a questionnaire about it. If you have previously experienced Green Comedy before, you will be asked additional questions about this experience. The entire procedure will take approximately 30 min.

What will happen to the information collected?

The data will be processed in accordance with Data Protection Law. The data will only be viewed by the researcher and her supervisor. Personal details that we have collected from you in the consent form will be stored separately from the data in a secure place. Data collected will be password protected on Onedrive. The data will be used for the completion of an MSc dissertation, and in the presentation of the results your data will be anonymised. We will ensure that there are no details included that could potentially identify you.

We will store the data until 40 days after the final exam board and will destroy it after that. If the findings are deemed to be appropriate for further scientific and professional communication, then the Onedrive data files and consent forms will be shared with my supervisor and stored according to the requirements of any identified outlet.

What are the potential risks?

There is an unlikely chance that the topics discussed may be stressful (e.g. climate change). Should you experience any discomfort during the research process, you can withdraw at any time.

What are the potential benefits?

By taking part in this research, you will provide a greater understanding of how comedy can be used as a tool in education. Additionally, to express our appreciation for your participation we will enter you into a prize draw to win a £10 amazon voucher.

Contact information

Please feel free to contact the researcher if you have any questions at s1530167@ed.ac.uk.

For general information about how we use your data go to https://www.ed.ac.uk/records-management/privacy-notice-research

Consent form

Below shows the information that was collected for the consent form. Participants were then given the option to click 'I have read and agree to the statements'. If they did not agree, they were not able to continue with the questionnaire.

Participant Consent Form

Title of Research Project: Is education a laughing matter? Investigating the use of humour in environmental education.

Statement by participant

1. I have volunteered to take part in this project
2. I know I can I know I can withdraw at any time without being disadvantaged
3. I am satisfied that the results will be stored securely
4. I know that the results may be published, but they will not be linked to me
5. I understand that my anonymised data will be stored as detailed in the information sheet.
6. I am aware of any possible risks and discomfortI agree to take part in this study

APPENDIX B - Demographic and baseline questions

Demographic questions

Participants could choose from multiple choice questions or supply further information if they chose the option 'other'.

1. What is your age?
2. On which continent are you local?
3. Are you fluent in English?To which gender do you identify most with?

Baseline questions

Participants could choose 1 = Strongly disagree, 2 = Disagree, 3 = Neither agree nor disagree. 4 = Agree, or 5 = Strongly agree.

1. I believe in climate change
2. I consider myself as someone who is knowledgeable about climate change
3. I consider myself as someone who does a lot for the environment
4. I am very worried about climate change
5. I think climate change issues will work themselves out
6. When I hear about the impact of climate change, I feel disconnected from it
7. When I hear about the impact of climate change, I feel fearfulWhen I hear about the impact of climate change, I feel hopeless

APPENDIX C - Post-viewing questions

Participants could choose 1 = Strongly disagree, 2 = Disagree, 3 = Neither agree nor disagree. 4 = Agree, or 5 = Strongly agree.

1. The show was entertaining
2. The jokes were appropriate
3. The comedian was relatable
4. The information and the comedian were reliable
5. The show was educational
6. I learnt something from the show
7. I would watch green comedy again
8. The information about climate change was easy to understand
9. After watching the show, I feel less fearful
10. After watching the show, I feel more hopeful
11. The show enabled me to reflect on my own environmental behaviourAfter watching the show, I am more likely to make changes in my life

APPENDIX D - Qualitative prompts

The following questions were asked, and the participants could answer in open-ended text boxes.

1. What kind of Green Comedy did you experience, and when?
2. Did you find it informative? If so, how did the comedian/educator achieve this?
3. What impact do you think it had on you then, now, and why?