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How does science fiction television shape fans' relationships to science? Results from a survey of 575 *Doctor Who* viewers

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Abstract

Fiction is often credited with shaping public attitudes to science, but little science communication research has studied fans' deep engagement with a science-themed fiction text. This study used a survey to investigate the impacts of television series *Doctor Who* (1963–89; 2005–present) on its viewers' attitudes to science, including their education and career choices and ideas about science ethics and the science-society relationship. The program's reported impacts ranged from causing participants to fact-check *Doctor Who*'s science to inspiring them to pursue a science career, or, more commonly, prompting viewers to think broadly and deeply about science's social position in diverse ways.

Keywords

Public engagement with science and technology; Representations of science and technology; Science and media

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Introduction

Science communicators have long been interested in how science and scientists are represented in fiction, often assuming fiction influences audiences' attitudes to science. Accordingly, fiction is frequently accused of stereotyping scientists and sensationalizing new technologies, or, more positively, credited with promoting science careers [e.g. Haynes, 2003; Steinke et al., 2012]. However, such assertions are often based on interpretations of a fiction text, not evidence of how audiences respond to it. Fiction is thus held responsible for public attitudes to science when its actual role is poorly known [Kitzinger, 2010].

Some studies of the experiences that shape engagement with science have indeed identified fiction as an influencing factor [Jackson, 2013; Maltese and Tai, 2010], so recent research has sought to investigate how. The rationale is sometimes practical: to explore how fiction can be used as a communication tool, particularly in health promotion which increasingly uses fiction to deliver health messages [Brodie et al., 2001; Davin, 2003; Hether et al., 2008; Howe, Owen-Smith and Richardson, 2002;

Levy, 2015; Pelto and Singh, 2010; Smith, Downs and Witte, 2007]. Researchers have also investigated fiction's impact on audience engagement with climate change [Leiserowitz, 2004; Lowe et al., 2006]; genetic research [Donkers and Orthia, 2016; Kitzinger, 2010; Reid, 2012]; gender and science careers [Simis et al., 2015; Steinke et al., 2012]; and science more broadly, including understandings of the nature of science [Jackson, 2013; Li and Orthia, 2013; Li and Orthia, 2016; Myers and Abd-El-Khalick, 2016; Orthia, Dobos et al., 2012]. Some conclude fiction can be effective for imparting scientific information if it is relevant to the audience [e.g. Levy, 2015; Smith, Downs and Witte, 2007]; it can influence attitudes towards matters like climate change or cloning, but not particularly strongly [Donkers and Orthia, 2016; Leiserowitz, 2004; Lowe et al., 2006; Reid, 2012]; it can sometimes shape characterizations of scientists and might role-model scientist careers, but there is sparse evidence [Li and Orthia, 2016; Simis et al., 2015; Steinke et al., 2012]; and it can sometimes awaken people's interest in science [Jackson, 2013; Li and Orthia, 2013]. Most studies suggest audiences process fictive content critically, fully aware it is fiction, and use it as a discursive resource to enrich discussions about science, rather than absorbing its messages wholesale [Green, 2019; Kitzinger, 2010; Orthia, Dobos et al., 2012]. Consequently, it seems that different people respond to a given text differently. Fiction is rarely observed to have a predictable linear impact on attitudes and knowledge.

One limitation of these studies is the question of any impact's longevity. Many have taken the form of 'immediate reception' studies, evaluating the immediate impact of viewing or reading a fiction text, often in an artificial viewing/reading environment [e.g. Orthia, Dobos et al., 2012; Reid, 2012]. Some have followed up weeks or months later, to see if any impact was retained [Donkers and Orthia, 2016; Lowe et al., 2006], but only a few studies have analyzed the impact on participants of a fiction text they had become familiar with over a longer period [Davin, 2003; Li and Orthia, 2013; Li and Orthia, 2016; Smith, Downs and Witte, 2007]. In addition, many of these studies have taken an evaluative form, assessing whether a fiction text achieved its communication aim, for example imparting safe sex information to audiences. Few have taken a more open-ended approach to investigating fiction's influence on audiences, and none have explicitly sought to examine a fiction text's impact on its readers/viewers after years or decades of personal engagement with it, despite evidence that close engagement with a text, identification with characters, and repeated exposure to ideas can make any impact more enduring [Davin, 2003; Hether et al., 2008; Smith, Downs and Witte, 2007]. Such ethnographic approaches to studying long term audience response have generally been restricted to fields such as fan studies [for example, Booth and Booth, 2014; Penley, 1997], but fan researchers rarely ask the kinds of questions that science communication researchers are interested in, such as the impact of a television series on attitudes to science.

In this study I sought to fill this gap by studying the impact of a long-running television series on its fans' attitudes to science and their career choices with respect to science. To achieve this aim I conducted a qualitative survey of viewers of the British science fiction television series *Doctor Who*.

Doctor Who, fandom and science

Produced by the BBC, *Doctor Who* is the longest-running science fiction television program in the world. Its original series was produced from 1963–1989, and production was revived in a new series commencing 2005. *Doctor Who* has inspired much spin-off media, including books and documentaries on 'the science of *Doctor Who*' [O'Keeffe, 2017; Parsons, 2006]. It has been broadcast in over fifty countries, gaining a global fan-base. While some *Doctor Who* fans are new to the series, others have been fans literally for decades; in either case, many put great energy into their engagement with the program [Booth and Booth, 2014]. All of this makes the program ideal for investigating the potential for a television show to influence its viewers over time.

Of relevance to science communication, *Doctor Who* is rich in science content and scientist characters. Its primary character, a time-travelling alien known as 'the Doctor', identified strongly as a scientist in the original series and continues to be associated with science. Aside from the Doctor, the show has depicted hundreds of scientist characters over the years (including in applied sciences such as engineering, technology and medicine), some of whom became the Doctor's regular travelling companions. Scholars have discussed aspects of how all these characters are depicted, including their gendered and racialized dimensions [Coppa, 2010; Jowett, 2017; Orthia, 2010; Orthia and Morgain, 2016; Tulloch and Alvarado, 1983; Yeager, 2013] and how they conform to or challenge scientist stereotypes [Haynes, 2003; Jones, 1997; Orthia, 2011b; Roach, 2011]. These studies suggest *Doctor Who* is usually but not always pro-science in its depictions of scientist stereotypes. It also overtly opposes gender- and race-based discrimination, but its stories nonetheless often endorse problematic discourses such as a characterization of science as masculinist, or the imperialist deployment of a western scientific worldview [Morgain, 2013; Orthia, 2013; Orthia and Morgain, 2016].

Beyond scientist characters, *Doctor Who* sits within the science fiction genre as an example of what Tulloch and Alvarado [1983, p. 41] call "'soft' socio-cultural scientific speculation". It often engages with science-related themes, including science ethics, the place of science in society generally, and specific controversial issues such as environmental pollution and genetic modification [Dubois, 2015; Fiske, 1984; Larsen, 2013; Orthia, 2010; Orthia, 2011a]. As a long-running show created by diverse writers, directors, actors and more, its ideological stance on these matters has varied considerably across time. Generally speaking, scholars have found *Doctor Who* is built on a foundation of optimism about science, its stories often using science to solve political problems [de Kauwe and Orthia, 2018]. At the same time, it is wary of some specific applications of science such as eugenics and unfettered industrialism, and is highly concerned about the misuse of science by people with malicious intentions.

However, audience responses to the show's depictions of science and scientists have not been studied systematically, so it is unknown whether these content analyses can accurately predict audience responses. In particular, beyond anecdotal evidence [e.g. University of Cambridge, 2017], it is unknown how *Doctor Who* has shaped people's personal relationships to science.

To find out, this study investigated whether *Doctor Who* fans interested in science were able to identify any contribution the show made to their relationship to science, and the nature of that contribution.

Methods

To investigate this I conducted an online survey of *Doctor Who* viewers. Originally intended as a scoping survey that would feed into a deeper ethnographic study, I assumed the sample would be small, so designed the survey to promote qualitative responses. However, the survey ultimately yielded 575 usable responses, enabling a full-scale study in its own right.

Survey design

After receiving ethics approval, the survey was constructed via surveymonkey.com. It had three question sets after initial screening questions. The first set asked about participants' *Doctor Who* viewing experience: how much of the original and new series they had seen, when they started watching it, and with what intensity. The second set contained the seven key questions:

Looking back on your life, has *Doctor Who* had any influence on:

KQ1. . . . the choices you made about your formal education?

KQ2. . . . your career choices?

Has *Doctor Who* in any way contributed to:

KQ3. . . . your views about the appropriate relationship between science and the rest of society?

KQ4. . . . your ideas about the role played by science in human history?

KQ5. . . . your ideas about science ethics?

KQ6. . . . your approaches to solving problems?

KQ7. . . . your vision of the what the future should look like?

To encourage qualitative answers, these questions were not structured as closed-response yes/no/maybe questions; respondents wrote answers in open-response text boxes. The questions were worded to encourage participants to reflect on their relationship to *Doctor Who* without assuming it had any influence on them.

The final question set was demographic, asking participants their birth year, gender, ethnicity and country of residence (open response), and their science education and science work histories (closed response with option to elaborate). These were asked last to minimize demographic self-consciousness when answering key questions.

Recruitment

Participants were recruited through a Facebook post with the neutral tagline 'Do you have things to say about Doctor Who and Science?'. The post was promoted by ScienceAlert, an Australia-based science news organization with >7 million

Facebook followers at time of survey. I chose this dissemination route to reach large numbers of science-interested people. The survey was open 3–10 October 2015, with 97% of responses submitted within 48 hours.

Of the 1039 surveys commenced, 575 provided usable data. Respondents who did not answer any key questions were excluded. Since no questions were compulsory after the disqualification set, ~10% of participants skipped at least one question, but I included their other answers because this did not affect their integrity.

Sample

Ninety percent of participants had seen all or most of the new series. In contrast, 23% had seen all or most of the original series, while 52% had seen only a little bit or none of it. By decade, 5% began watching *Doctor Who* in the 1960s, 28% in the 1970s or 1980s, 8% during its production hiatus (1990–2004), and 58% in the new series era. Almost all participants watched the show obsessively or regularly; only 5% watched intermittently.

Birth years ranged from 1942–1997, corresponding to ages 18–73 (median 32). Participants ranged from 1–57 years old when they started watching (median 17; median 7 for those who started pre-1990). Fifty-nine percent of participants identified as female, 40% as male and 1% as gender fluid or non-binary. About 85% of respondents reporting an ethnicity listed a European ethnicity or a variant on 'Caucasian', while about 15% identified with a great range of non-European ethnicities. Participants were drawn from 37 nations, four of which were listed by $\geq$10 people: Australia (289), U.S.A. (136), U.K. (21) and Canada (19).

Most participants had completed or were completing a Bachelor or higher degree in a science-related field (69%). An additional 11% had studied tertiary-level science in another capacity, such as trade studies. However, only 48% of participants had worked in a science-oriented job, and 35% were currently working in one. Some were not working in their chosen field because they were still studying or were obliged to follow available work.

Data analysis

For the present paper, I analysed key questions at an overview level, summarizing major trends in the data. The huge size of the dataset (in total, responses to all key questions comprised ~58,000 words of material) will enable more detailed examination of individual questions in future studies.

To facilitate analysis, I manually sorted answers to the key questions into 'yes,' 'no' and 'maybe' categories. Responses were generally classified 'yes' if that seemed unequivocal, for example if the word 'yes' or similar appeared in the answer, or if the response stated clearly that the show had contributed to their ideas or choices. Similarly, responses were classified 'no' when that was unequivocal. More ambiguous responses were classified 'maybe.' Below I report the distribution of answers into these categories, but the numbers should be treated with caution. Given the self-selected participant pool and targeted nature of the survey, the

numbers are unlikely to be indicative of any larger societal trends, and are presented here to provide context for the qualitative analysis.

After sorting answers, I analyzed them qualitatively. Because the aim was to explore any ways *Doctor Who* had contributed to participants' choices and ideas, and the relative strength of those contributions, I focused primarily on the 'yes' responses. For this study, I inductively grouped responses that took a similar approach to answering the questions, to enable me to review efficiently the broad types of influence I could identify at that macro level. Future studies may be able to take a more nuanced thematic analysis approach [Braun and Clarke, 2006].

When selecting example quotes, I sought to maximize response diversity, including any particularly strong statements of impact, but avoiding multiple quotes from the same participant. In reporting quotes, I corrected minor typographic errors when needed to enhance their readability; corrections are indicated with square brackets. Idiosyncrasies not affecting readability are unchanged. All quotes are attributed to a unique participant number which corresponds to the dataset of 575 included responses, attached as supplementary material.

Results

Quantitative patterns among participants

The responses revealed *Doctor Who* had contributed to participants' life choices and ideas about science to a relatively high degree (Figure 1). The two key questions about *Doctor Who*'s influence on education and career elicited the smallest number of 'yes' responses, respectively 13% (n=74) and 9% (n=49) (all percentages calculated for the whole sample n=575, including non-responses). A further 12% (n=69) and 11% (n=66) gave a 'maybe' response to these questions, usually signifying that the show influenced them a little or reinforced pre-existing interests. For all other key questions, 24%-37% of participants gave a 'yes' response when asked about *Doctor Who*'s contribution to their views, while 16%-27% were coded as 'maybe'. While the 'no' response to the education and career questions was high at 75% and 78% respectively, it averaged 41% for the other five key questions (range 37%-48%).

Contributing to these patterns was a cohort of 107 participants (19%) who consistently answered 'no' to six or seven key questions without giving a single 'yes' answer; 68 of them answered 'no' to all. Participants who answered 'no' to key questions frequently kept responses brief. Where they did elaborate, the main reasons for answering 'no' to any key questions were: the participant rejected the notion of a fiction text influencing them; their views on science had not changed since watching the program; their views and decisions were shaped by other factors; or *Doctor Who*'s depictions of science were too inaccurate, fantastical or trivial to have an impact.

In contrast, only 19 people (3%) answered 'yes' to six or more key questions (only three to all seven), suggesting the survey did not inadvertently lead participants towards 'yes' type answers. In total, 398 participants (69%) gave a 'yes' response to at least one key question, so for over two thirds of participants, *Doctor Who* contributed in some way to their ideas about science and/or their life choices. This high number likely reflects the self-selected nature of the participant pool, since

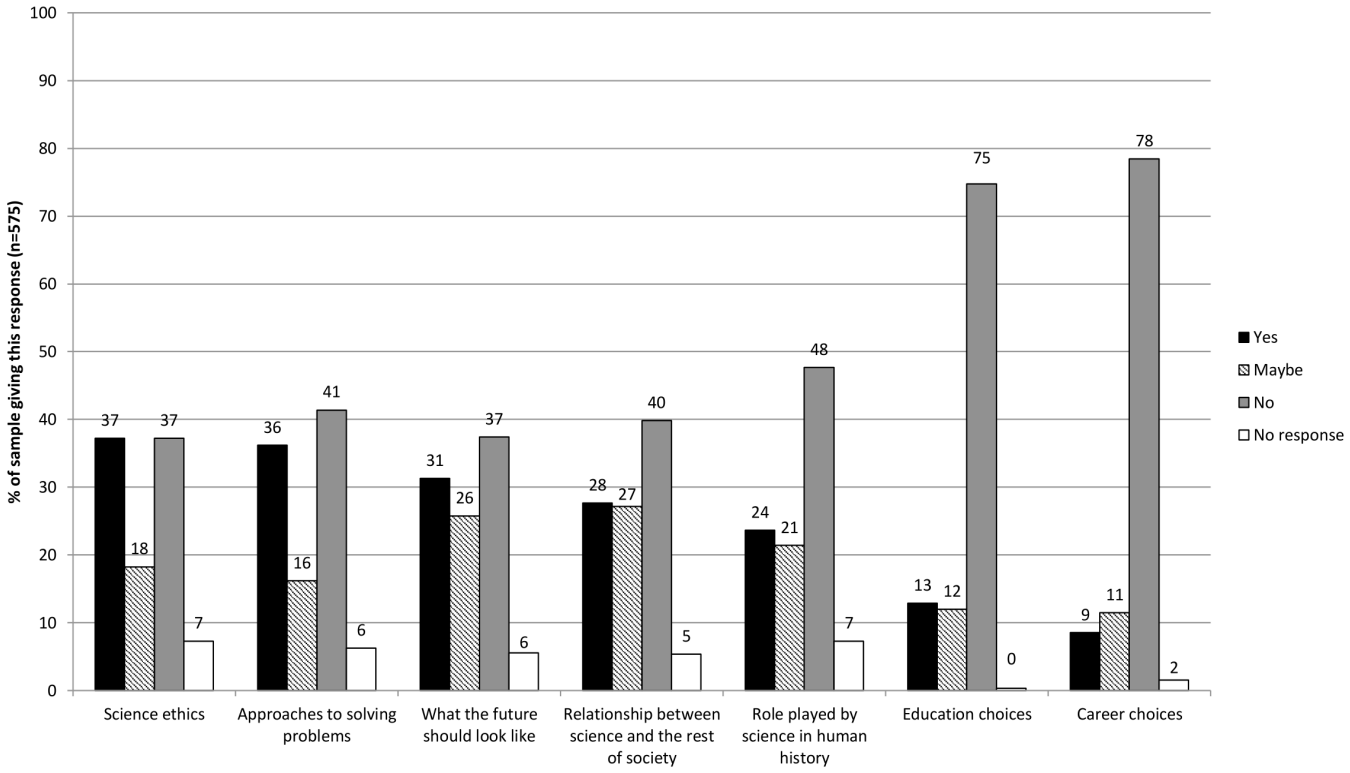

Figure 1. Quantitative summary of responses to key questions, coded into 'yes', 'no' or 'maybe' responses. Percentages rounded to nearest whole number.

people whose relationship to science was influenced by *Doctor Who* may have been more attracted to the survey. Nonetheless it demonstrates more than anecdotally that a television program can influence its viewers' relationship to science.

Qualitative analysis

Education choices. The participants who said *Doctor Who* influenced their formal education choices reported diverse types of influence, including inspiring their interest in studying particular fields, encouraging them to value education more, and helping them develop other knowledge-related skills. For many, the direction of influence was towards studying science:

> *'Yes, I started taking science classes right away!'* [#50]
>
> *'Yes. It made me want to learn more about science. I became a science major [because] of it.'* [#328]
>
> *'Doctor who has influenced [my] interest in science at a young age, which [led] me to select certain electives throughout my education.'* [#87]

Where participants specified a scientific field of study, they included physics, astronomy, mathematics, engineering, computer science, environmental science, chemistry and psychology:

> *'Yes I got more interested in science and mathematics. I took both subjects at sixth form'* [#121]

'Yes, it ultimately got me interested in physics and cosmology, and I ended up changing my major from Political Science to Astrophysics.' [#571]

'I have a degree in Environmental Science specifically because of watching the 4th Doctor deal with oil rigs. That and the Exxon Valdez made me want to change things.' [#49]

Some 'maybe' responses also linked *Doctor Who* to studying science, either stating that the show reinforced a pre-existing interest, it may have influenced them but they weren't sure, or it made science more engaging:

'Very little; however, I do believe it made biology and chemistry seem more interesting when I did have to take them for my program.' [#372]

Science was not the only discipline *Doctor Who* inspired participants to study: history, sociology, linguistics, law, video game development and creative writing were also mentioned. A few participants said it influenced their development of other skills, including leadership, persistence under stress, and self-taught technical skills. *Doctor Who* also taught some participants to value education, knowledge, intelligence and curiosity, shaping their life choices:

'As a kid it was great having a role model who used intelligence and problem solving to save the day. It probably encouraged me not to play dumb and pick intermediate level subjects simply to fit in with peers.' [#56]

'I went on to higher education because Doctor Who lit a light in me to want to learn…everything!' [#41]

Career choices. Of the participants who answered 'yes' to the career question, about half said it contributed to their decision to pursue a career in science-related fields, science communication or teaching. Many of the 'maybe' responses expressed similar sentiments, that *Doctor Who* possibly played a role in reinforcing that decision, or (for younger participants) that it may play a role later:

'It made me want to become a scientist, an engineer, and a researcher. To one day be part of pushing humanity towards the stars.' [#75]

'Yes, I am currently job hunting and Doctor who has influenced me to look for jobs related to space exploration and research and/or jobs teaching kids science and history' [#108]

'Yes, I am now a secondary science teacher. I decided that rather than pure research for a Ph.D. I enjoyed talking about science and teaching science. I think Doctor Who lead me down this path, and probably with sharing of knowledge and education too.' [#244]

Doctor Who would have influenced other participants except other obstacles got in the way:

'Yes, but I lack the funds to pursue.' [#185]

'No but if I had the right credentials it definately would have an influence' [#101]

For other 'yes' or 'maybe' participants, *Doctor Who* encouraged their career style or their approach to building a career, for example affirming decisions to work freelance, or influencing their passion for the helping professions:

> *'i will only work in sectors which are doing the right thing by the planet and humanity. Eg environment protection.'* [#181]
>
> *'the doctor chose that name to fix things i chose aged care'* [#269]
>
> *'If choosing not to follow a traditional career path and operating freelance and trusting myself and my abilities then yes.'* [#342]

The program also reassured some 'maybe' participants of the legitimacy of their choices:

> *'the show validates my ideals even when I came up against the reality of the discrimination against women in scientific fields.'* [#400]
>
> *'I guess the show tells you that it's okay to be nerdy, that cleverness and scientific knowledge are things that can saves worlds. I have always wanted to pursue a scientific career but DW definitely makes me more proud about doing what I'm doing.'* [#529]

The science-society relationship. The responses coded 'yes' for KQ3 expressed a diverse range of ideas about the appropriate relationship between science and society. The most common overall theme was that *Doctor Who* promoted the positive value of science. This was sometimes expressed as an impact on the participant's own relationship to science:

> *'it's made me hold a higher respect for people who do science!'* [#53]
>
> *'It prompted me to view science as a way of life, not just a tool.'* [#243]
>
> *'It [made] science seem like a natural part of the world and society to me when I was a kindergarten aged toddler and I'm sure that's continued as a result of that.'* [#272]
>
> *'Dr Who makes it clear to me that Science is an essential part of understanding the world around us. If society is to advance and continue having intelligent discussions about this world then society should have at least a basic understanding of science'* [#575]

More often, however, participants said the show demonstrated the importance of promoting science to *other* people, possibly reflecting participants identifying their own values within the show rather than being a type of 'influence' as such:

> *'I think it's a great way to get people, especially children, interested in science. It teaches all of us, as a society to question the things around us.'* [#338]
>
> *'Kind of, it makes me want to ensure my children understand science and don't take everything on face value'* [#187]
>
> *'It has made me feel the general population should have better basic scientific knowledge. Myself included.'* [#316]
>
> *'It has helped convince me that science needs to be more widely understood and appreciated.'* [#512]
>
> *'Yes, it has made me wonder about the vast uneducated mass. They have a broad understanding of topics, but no real detail understanding. This is used against people in Doctor Who and it is used against the masses in daily life in political decisions.'* [#382]

Where participants commented more specifically on the appropriate way for science's representatives to engage with people, their views were sometimes contradictory, yet all were attributed to *Doctor Who*:

> *'Yes. The biggest lesson — "Do not waste time trying to explain obvious things to bigoted or stupid people"'* [#556]
>
> *'It has taught me that science has its place, but that it is not necessary for it to be pushed on everyone. Customs and beliefs are also a valid means of understanding the world around us, and societies can thrive without the addition of science. It also reminds me that science is to serve humanity, not to be held up in arrogance.'* [#499]

Finally, several participants answered this question with reference to science ethics, pre-empting KQ5. These participants expressed a view that science could be either positive or negative, so consideration of ethical questions should be integral to the relationship between science and society, and *Doctor Who* had enhanced their thinking about these matters:

> *'Absolutely, the classic line about 'we are scientists; we buy our privilege to experiment at the cost of total responsibility" immediately springs to mind. The Whovian philosophy has been that science should be conducted ethically and responsibly in the service of humanity.'* [#304]
>
> *'Watching the show has allowed me to consider questions I otherwise would have been ignorant of. It has shown what could happen when technology is well appropriated into society and also (mainly) when it causes strife.'* [#520]
>
> *'Yes. Science discovers or invents something and the government steals it and weaponizes it. Once this was pointed out I began to watch for real life examples.'* [#536]

Science and history. Of the people who stated *Doctor Who* had shaped their ideas about the role of science in human history, many indicated that the program had enhanced their understanding of this topic, even while acknowledging the show did not always adhere to historical fact. For some participants, *Doctor Who* inspired them to find out more about science and history via other means:

> *'It's made me learn more about history than science. Some of the historical references have made me brush up on my history knowledge.'* [#216]
>
> *'Its somewhat furthered my ideas by encoraging me to fact check the science of doctor who'* [#18]
>
> *'Older episodes were the prompt for a visit to the library or book shop'* [#353]

For others, *Doctor Who* had a more direct educational impact. Echoing the responses to KQ3, a common theme was that *Doctor Who* demonstrated science's importance to human history:

> *'It has shown repeatedly how science makes a big difference in society and how it can beautifully shape the future of humanity.'* [#80]
>
> *'It shows how our course as humans has been altered by various scientific discoveries, and it made me think more about how we've changed because of it.'* [#395]

> *'Maybe not what roles they play but the gravity of those roles. Science has done a lot — that's something I've always known but just how BIG that role is was something I only really appreciated watching doctor who'* [#505]

In terms of more specific ideas, a number of participants mentioned technological inventions as key to turning points in human history, while others focused on the role of science in combatting worldviews based on superstition, religion or ignorance:

> *'Yes. Science has fueled a number of historical events and the show, while it shows fantastical depictions, highlights that without such advances as clockwork, steam power, and such that we would not be where we are now.'* [#376]

> *'Truly made me understand the origins of religion. People need explanations to calm their fears. If civilization isn't advanced enough to technically explain, for example, thunder, then it must be the actions of a god.'* [#536]

The time travel theme of *Doctor Who* also encouraged some participants to adopt a view of history as contingent and alterable:

> *'It makes you think about cause and effect, how even a small amount of new technology accidentally dropped before its time could have altered history as we know it. The impact of technology before the world was ready for it.'* [#490]

Science ethics. The question about the show's impact on ideas about science ethics elicited the highest number of 'yes' responses of the seven key questions. This impact manifested very consistently, with the vast majority of 'yes' responses indicating *Doctor Who* had encouraged participants to think more deeply or broadly about the ethics of science and had opened their minds to new ideas in this area. The specific ethical questions participants considered were diverse, with topics including: notions of personhood and what it means to be human, particularly in light of technologies like cloning and anatomical enhancement; the role of live experimentation in science and cruelty or compassion towards living things; the concept of sacrificing one individual for the greater good; the ethics of interfering in other cultures; the ethics of things like environmental pollution, artificial intelligence and weapons technologies; and the ethics of time travel.

More generally, many participants referenced the moral ambiguity of science and its potential for doing both good and bad, following this with comments on the need for caution in science. Within this context, several people specifically reproduced a variant on the sentiment, 'just because we can, doesn't mean we should'.

Several participants commented on the institutional management of science ethics, most asserting the importance of ethical regulation. However, a couple of people drew different, even contradictory, conclusions from *Doctor Who* about the appropriate relationship between science and ethics:

> *'it has taught me the importance of scientific ethics and not to venture into science until the effects are fully understood.'* [#494]

'Yes. Strong ethical guidelines and laws need to exist, and be enforced. Science isn't the problems, but misuse of its advances can be.' [#266]

'The show presents viewers with lots of unethical science. It did help me understand that science is unbound by ethics.' [#117]

'Yes. Ethics are paramount. Unless they get in the way.' [#162]

'Yes…We should stop putting ethics in the way of scientific research' [#543]

Problem solving. Among the 'yes' responses to KQ6, over half stated *Doctor Who* had encouraged the participant to think 'outside the box' when faced with a problem, and/or that it had improved their resilience when grappling with difficult problems, encouraging them to persist. Less commonly, some participants asserted they had learned from the show that problems can be fun to solve, and that 'having a go' was worthwhile.

In terms of responses more directly relevant to science, some respondents indicated the show had driven them to use more evidence-based, logical, observational or empirical approaches to solving problems:

'Yes, I have become more evidence based problem solving' [#287]

'Yes, i am now more likely to approach a problem logically as opposed to emotionally' [#449]

'I suppose it has shown me how to be more empirical in my approach to problem solving' [#495]

'I think it's helped by to be more analytical when tackling a tougher problem' [#507]

Others stated that the program had encouraged them to listen more to other people, cooperate and approach problems with compassion and humour:

'I guess I started to think, no one should work alone solving problems:)' [#240]

'Yes. I try to remember that with the proper application of empathy and logic I can resolve most problems.' [#376]

'Doctor Who shows people solving problem through cleverness, compassion and cooperation, using non-violent means. This inspires me to do the same.' [#233]

A few mentioned that *Doctor Who* was a useful teaching tool for them, when working with students or their own children:

'I normally wouldn't have said so but my son often asks "what would the doctor do?" if faced with a science theory question' [#490]

What the future should look like. About half the 'yes' responses to KQ7 stated *Doctor Who* had contributed positively to their vision of what the future should look like, sparking their imaginations with new technologies, more harmonious social relationships, and the possibilities of space travel and alien life. A much smaller number said the show contributed negatively to their vision of the future, through dystopian scenarios that illustrated what the future should *not* look like. A few participants responded that *Doctor Who* did both of these things.

Some said that by showing different future possibilities, the program gave them hope or guidance about what actions to take in the present to bring about a better future. However, the specific solutions they distilled from the program differed, for example:

> *'Yes. I gives me hope that scientists of my generation and the future can have a level of ethics when conducting their research.'* [#159]
>
> *'Yes it has. I see the future being intelligent enough to rid the world of religion and hatefilled views towards other races. If the future does not see this, we will be lost.'* [#174]
>
> *'Prior to watching the show, I had more or less presumed that, due to global climate change, the future would look quite bleak. Human society in this view supposed constant violence and hunger, disturbing and perhaps ending civilization itself. But the show encourages me to look forward to a much brighter future with its relentless optimistic bent. I am now hopeful that we can all work together to solve the many challenges ahead.'* [#357]

Discussion

This overview of a survey of *Doctor Who* viewers amply demonstrates that engagement with a fictional television program can have a significant impact on some people's education and career choices, their views on science's place in society, and the ways they think about solving problems and the future. The kinds of impact documented here are consistent with the range of potential impacts previous researchers have predicted. Most commonly, *Doctor Who* prompted viewers to think more deeply or extensively about a science topic, by introducing them to new ideas and illustrating the consequences of particular scenarios. This is not a surprising response, since commentators frequently attribute such functions to science fiction as a genre [Evans, 1988], however this study is the first to document it qualitatively beyond an anecdotal level. Other impacts ranged from being inspired to find out more about a science topic to choosing an entirely new career path. Some participants felt encouraged to employ new approaches to problem-solving in their daily lives. Others adopted a more positive attitude to learning and knowledge in general. The study confirms that fiction texts can indeed be effective as science communication tools. They can be used to spark interest in science in large and small ways, and they can prompt some viewers to engage deeply with current science debates.

In concert with the predictions of previous studies, however, this study shows the same television program will not impact every viewer in the same way — and, importantly, many viewers will not be influenced at all. Participants sometimes drew contrary conclusions about a topic, even while drawing from the same program, and others simply refuted the possibility of taking fiction seriously enough to be influenced. This is consistent with the observation by previous scholars that *Doctor Who* itself presents diverse perspectives on science topics. It is also consistent with previous studies' findings that fiction audiences will inherently react differently to texts, because they will process a text's content in light of their existing understandings and prior life experiences as well as their critical attitudes towards fiction.

Nonetheless, some common themes arose from the 'yes' responses to the survey. Most obviously, it was common for participants to report that *Doctor Who* had

made them feel more positively towards science, even while acknowledging the show had opened their eyes to the possibility that science could be used for good or evil. Viewers also often described *Doctor Who* as supportive of human equality in terms of things like gender, race and sexuality, but did find messages within it that were anti-religious or pro-western in their scientific orientation. This response is largely consistent with previously published analyses of *Doctor Who*'s depictions of science. This suggests that scholarly content analyses, if carefully constructed, have a legitimate role to play in this field of research, as broad predictors of the social meanings fiction texts have for the larger body of viewers. However, the level of agreement between scholarly interpretations and viewer response was enhanced when considering the whole of *Doctor Who*, rather than specific episodes. Some survey responses referenced specific episodes for a particular point, but reflections on the overarching ideological bent of *Doctor Who*, and the kinds of questions it raises, were more clearly consistent with scholarly analyses.

Limitations and future research

This study is an overview report of survey results, and space prohibits a more detailed analysis. The complete dataset is available online to enable future researchers to analyze it in detail. A necessary limitation is that the survey targeted self-selected participants interested in science and in *Doctor Who*, so it should be interpreted as a study of a particular group not representative of broader trends. A similar study of *Doctor Who* fans not pre-identified as science-interested would be informative. The study was also limited by the inability to ask (the anonymous) participants for extrapolation on their responses, for example to find out *why* they thought the show had an impact, or *why not*. Future work could interrogate such questions more deeply, as well as exploring themes such as perceptions of scientist characters or the relationship between science and religion.

Conclusion

This is the first study to investigate the impacts on people's relationship to science of engaging with a specific fiction text over a long time period. It has provided substantial evidence that fiction can sometimes have profound, lasting impacts, even stretching across decades. For many *Doctor Who* fans, the impact was a cumulative result of the show's general ideological orientation and its repeated interrogation of questions like those pertaining to science ethics. For a small number of others, a significant impact was traceable to a single episode.

This study demonstrates the potential importance of fiction as a science communication medium. It also demonstrates the contingent and unpredictable nature of fiction's impact on its diverse audiences, because people will sometimes interpret its embedded key messages differently, and they will have different personal contexts in which to apply new information and ideas.

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