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How prominent science communicators on YouTube understand the impact of their work

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YouTube is rapidly becoming one of the major places that people around the world engage with science, in turn making prominent science communicators on YouTube some of the most impactful and known faces in science communication. However, while much is known about the viewership habits of YouTube audiences, little is known about the motivations, thinking and ideas of impact of the science communicators working on YouTube. The current study qualitatively explored these questions one-on-one interviews with prominent science communicators working on YouTube ($n = 20$). We explore their responses in six key areas: their understanding of and relationship with their audience; their attitude toward impact metrics; their attitude toward comments; their understanding of impact; their reasons for creating content; and what it is like working under the algorithm. Key findings include a wide variety of opinions about the metrics provided by YouTube; a near unanimous assertion of the value of comments; a somewhat deficit model approach to their communication work; and a polarized attitude to working under the algorithm.

KEYWORDS

YouTube, science communication, science media, informal science learning, video, impact

Introduction

Science communication is traditionally thought of as the activities of scientists, journalists or public information officers disseminating research, as well as factual television and documentaries (Treise and Weigold, 2002). However, the emergence of the internet and social media has redefined the media landscape, allowing a range of professional, independent, and amateur content creators to reach new audiences (Juhasz, 2009). Of these platforms, YouTube can fairly be described as a behemoth—not only the second most popular search engine, it is used by one-third of the world's internet-using-population (Allocca, 2018). Importantly for those exploring the communication of science, it is, of course, increasingly a destination to which audiences are turning to engage with science (Brossard, 2013). In fact, YouTube—and hence the science

communicators who work there—now represents one of the most important sites for the communication of science (Brennan, 2021).

Alongside this, a growing body of science communication literature has sought to understand the communication of science on YouTube. Scholars have, for example, shown that viewers who seek out science videos are motivated by an enjoyment of science (Rosenthal, 2018); that the great bulk of students (some 91.2%) use YouTube in educational contexts (Mustafa et al., 2020); that “user-generated” and community oriented content is engaged with more readily than “professionally generated content” (Welbourne and Grant, 2016; Geipel, 2020); that in comparison to scientists being interviewed on television, science YouTubers are considered more entertaining and comprehensible by audiences (Reif et al., 2020). In short, science YouTubers are now—and are becoming ever more—a highly influential group in the communication of science, and are some of the most known faces in science communication (Brennan, 2021). However, few studies have examined the motivations and challenges of YouTubers creating science, technology, engineering, and mathematics content (herein referred to as “Science YouTubers”).

To fill this knowledge gap, in what follows we report on a series of qualitative interviews with prominent Science YouTubers to understand their motivations (i.e., the motives and goals underpinning content creation; Kanfer, 1990) and challenges: why they create content, how they think about their audience, and how they define impact. The present study will contribute to the understanding of science communication in practice, and enable future research to be tailored toward the highly influential group of science communication content creators.

Methods

Design

A one-on-one interview design was chosen to both minimize social desirability bias between participants that may present in a focus group, and to maximize participant involvement due to scheduling flexibility. Interviews were conducted during September and October 2021, by three of the authors of this paper (WG, MM, and IS). An interview guide was developed by all authors prior to the interviews, and used throughout. Participants were asked questions pertaining to their motivation to create videos, how they define their audience, think about their relationship with their audience, approach metrics, think about the algorithm, and define impact. Interviews were conducted on Zoom (Zoom Video Communications, San Jose, USA). The duration of interviews was 60 min or less and interviews were conducted in English. The interviews were recorded, with the audio auto-transcribed

to text using transcription software Otter.ai, where participants were anonymised. Ethical approval was granted from the ANU Human Research Ethics Committee (Protocol 2021/461).

Participants

The target participants were prominent science communicators on YouTube. The inclusion criteria were that they were: (1) creating user-generated content (i.e., not employed by an external media or educational organization); (2) generating income from YouTube (i.e., not creating videos as a hobby); and (3) creating content in the English language. Participants were recruited through a Slack channel of over 200 educational YouTubers (WeCreateEdu, 2021) and the professional network of one author (VH). Participation was voluntary and interviews were conducted until a high level of data saturation was reached.

Data analysis

The data were analyzed using thematic analysis to identify and report recurring themes, considering the frequency of data patterns (Braun, 2006). Data analysis was independently undertaken by two authors (VH and WG), with any discrepancies discussed and resolved. The names for different themes were agreed upon by all authors to represent the nature of each theme, including the choice of quotes presented.

Results

Twenty participants were interviewed ($n = 20$) from 35 interview requests. Of those, 60% identified as female ($n = 12$) and 40% identified as male ($n = 8$). Participants were located in the United States of America ($n = 15$), Australia ($n = 4$), and the United Kingdom ($n = 1$). The age range was 25–40 years old, with a median age of 33 years. As of October 1, 2021, participants' YouTube channels ranged from 127 to 10,200,000 subscribers, with a mean of 1,600,518 and a median of 217,500 subscribers.

Six themes were developed during the thematic analysis process, exploring the motivations, thinking and ideas of impact of the science communicators making these videos. These were: (1) Relationship to a three-dimensional (3D) audience; (2) Divisiveness toward metrics; (3) Value of comments; (4) Orientation toward impact; (5) Prioritization of intrinsic factors; and (6) Working under the algorithm.

Relationship to their audience

It is perhaps one of the defining features of social media that content creators working on platforms like YouTube are able to experience far closer relationships with their audience than creators working in more traditional forms of media (Chen, 2016). Cyber optimists will of course note this closeness affords an ever-richer understanding of and interaction with that audience, and the creation of ever more targeted, more useful and (potentially) more engaging media. Could the vast industry of makeup tutorials on YouTube have grown so large without an ever-evolving understanding of what audiences want to know? Cyber pessimists, meanwhile, will point in reverse to the downsides of collapsed distances between creator and consumer, with hostility and the dangers of parasocial relationships never far from the surface (see for example Amarasekara and Grant, 2018).

But how do content creators themselves feel about this relationship? In what ways do prominent science communicators on YouTube think about the relationship between themselves and their audience?

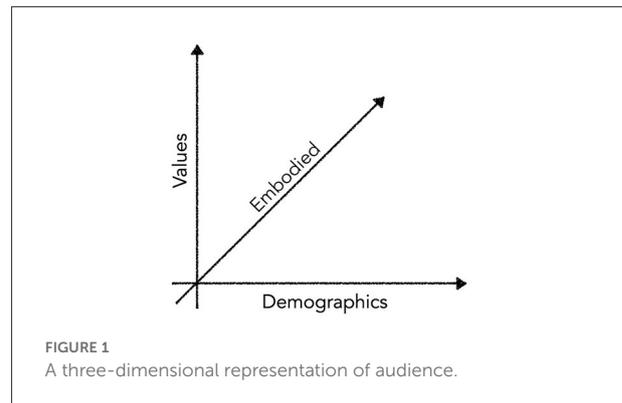
In general, when asked how they defined their audience, participant responses were rich and expansive. Many had thought deeply about who their audience was and the relationship they wanted to have with them. As at least one participant noted, “I think about my audience a lot”; another offered “I’m thinking about the audience all the way down to... should I include the name of this molecule... and that just permeates the whole process.”

Defining the audience

We explored how Science YouTubers considered and framed their relationship to the audience. Two prominent categories of audience definition emerged—with a third occasionally touched on, but much less commonly than the others. Most common were “demographic” definitions; next were “values” definitions; finally, some raised what can be called “embodied” definitions. Though these three categories certainly interact (for example, there are of course interactions between demographics and values), they can be considered for the point of the discussion here to be three dimensionally orthogonal, as rendered for illustrative purposes in Figure 1.

Defining the audience by demographics

The most prominent category of audience definition was demographic. When asked how they defined their audience, many of the participants (though not all)—reached directly for demographic categorisations. “I am,” one respondent noted, “talking to a bunch of 10-year-old kids.” Others added similar sentiments:



“My audience is very male... of the 18–35 age range”
“I’m going for everybody. I’m going for the 5-year-old, I’m going for the 95-year-old PhD”
“My audience is predominantly male, like 90/10% male female”
“They’re a bunch of like older white men.”
“Majority male, but perhaps a little bit younger”
“My audience is 50/50, male and female”

Within these statements we can see a blend of comments about the audience sought (“I’m going for”) and the audience actually reached (“my audience are”). Indeed, some who reached for demographic definitions of their audience took the opportunity to register—or bemoan—differences between the audience they got and the audience they desired. As one participant noted, “I think that’s kind of a funny question. Because there’s like the audience ... you want to reach and the audience that you reach, and they’re potentially very different.” Along these lines we heard things like

“My audience is mostly male unfortunately”
“Why aren’t there more women?”
“I wish it was more female, but I don’t think I can control that”

Within this category some also alluded to what might be called a “double audience” or “dual audience”—speaking to two groups of people at once. “I know,” one participant stressed, “that I do have that dual audience.” The most obvious forms of double audience mentioned were parents and children, and teachers and students. One noted, for example, that “part of the audience will be parents.” For them this meant at least two things: crafting content that spoke to both children and parents (“So I’m also mindful of... making sure that there’s things in the video... parents will enjoy and will laugh at as well”), and deliberately building trust with parents (More will be explored on trust below).

However, a second type of “double audience” could also be found in participants’ thinking. Here what might be considered their public account of their audience—which could indeed be a segment within which they might be having significant impact—differed from the people who actually watched their videos on YouTube. One participant here told stories of working deliberately to achieve—and indeed achieving—significant impact amongst women (“every single adult woman at [an event] came up to me and said that they only [participated] because they saw my video”) that contrasted with the quantitative metrics on the bulk of their audience (“My audience is alarmingly skewed male, I think it goes up between 96 and 99%”). An uncharitable reading of this situation might suggest a possibly duplicitous public presentation, but it is probably fairer to stress (as we explore below) that views are not the only, or even most important form of impact sought by our participants. For many of our participants YouTube represents a useful—but not sole—form of public engagement. A well-received channel on YouTube might be a launch pad for other forms of engagement, where participants can have more of the forms of impact they desire.

Defining the audience by values

The second way participants defined their audience can be grouped as “values” definitions—based on things that the audience cared about or were focused on. As noted in Figure 1, these can be considered at least partly orthogonal to demographic variables: while two 42-year-old Australian women might share a number of demographic similarities, they might also care about radically different things. Thus, within this category, many participants spoke of general curiosity or appreciation for science:

“I want to reach people who are curious”

“They value curiosity. They value honesty, as opposed to like, sensationalism”

“I think people that watch my channel care strongly about science”

“For the most part... very nerdy, very interested in the world”

Others talked of those struggling with schoolwork:

“I don’t want students to feel the way I felt when I was taking the class and struggling”

“People who want to do well in school”

“Struggling with biology”

Others spoke more politically, or perhaps more philosophically about their target audience:

“I think they care a lot about what I would categorize as sort of liberal values”

“I think people hate-watch my stuff”

“I just view the audience as actual humans who have actual feelings, not as someone that I’m trying to convince of something. They’re just real people. Yes, that’s kind of how I feel. Souls if you will”

Along these lines, we also asked participants how they wanted their audience to feel after watching their videos. Participants here spoke of wanting their viewers to feel “excited... an excitement for science”:

“I want them to feel positive, confident... curious”

“Empowered”

Defining the audience by embodiment

The third category of audience definition can be termed the audience’s embodied or physical setting. This category was mentioned much less frequently than the demographic or values categories discussed above, and was certainly not as richly developed in participants’ thinking. In fact, it was almost conspicuous in its absence, particularly when we compare investigations of other social media, such as Chin et al. (2017) exploration of where people listen to podcasts. Nevertheless, some slight elements of this thinking can be seen; perhaps in noting geographical locations, such as

“My audience is in the United States...” or

“They’re located typically in English speaking countries...”

“Kind of all over the world I think I get like 35% American and then it’s India etc.”

Others offered something a little closer, such as parents with children, or watching in class:

“Parents sitting down watching it with their, with their children as well.”

“Children watching it on their parents’ devices”

“I... [get] emails from teachers saying that I play this in class”

Interestingly, none offered anything further on their audience’s embodied location, whether watching at a desk or on a bus, or on a computer or smartphone or a smart TV. This suggests perhaps a lack of relevance of this category to our participants, or perhaps a feature of online video.

Dialogue with audience

Beyond how they defined their audience, we also sought to explore the relationships participants wanted with their audiences. Here a number of participants were explicit in defining the relationship they sought as one of role modeling and mentorship. While sentiments along these lines were articulated

by male-identifying participants, this position was far more explicit amongst female identifying participants. For example:

“It feels like a mentorship... Yeah, it feels like a mentorship... I feel like I’m, like an older sister or their tutor”

“But also, because I was very aware that even when I was growing up, you know, there’s very few women role models that are public facing... not just to girls, as most people jump to you, but also the young boys watching as well, that shows them you know, this is not just something that boys do.”

Along similar lines, a number of participants stressed they wanted their relationship with their audience to be understood in terms of—and shaped by—“authenticity”:

“I try to optimize for authenticity”

“Just be authentic”

“...reach people in such a way that is pure and genuine.”

The desire to be—and be considered—authentic was paralleled in a desire to build trust with their audience. One participant noted this explicit connection, “it’s everything, man. It’s absolutely everything”:

“Like if I were ever to manipulate, or lie or not be straightforward. The way I say it is your name is worth more than gold. That’s from Proverbs. And so the most important thing is authenticity, authenticity and trust.”

Others delved into the particular audiences and stakeholders they wanted to trust them:

“I want scientists to trust me... and then I want the lay people to trust that I’m... conveying knowledge that is accurate... So I want trust on both sides”

“I think that helps to build trust that parents... Yeah, like, Yeah, because I do know, there are some parents who say, Oh, we do watch your videos first.”

Finally, a number of participants stressed a desire for some sort of two-way relationship with their audience—either conceptually, or concretely *via* the YouTube comments section. Interestingly, while others have noted the potential for hostility in YouTube comments (see for example [Amarasekara and Grant, 2018](#)), our participants were almost unanimous in seeing significant value in the comments, or indeed bemoaning their absence. While we explore more on the value of comments below, a few points about dialogue are worth observing here.

Conceptual ideas of dialogue included:

“I want to talk with people rather than talking at people”

“Where people could feel free to ask questions that they’ve always wanted to know the answer to, that they’ve never been able to find the answer to.”

More concrete ideas of dialogue pointed directly to the comments section:

“I felt like if I could explain something to somebody else, and that meant I knew the subject really well. And also YouTube was the scariest place I could do it. And because people would comment if I was wrong.”

“Sometimes I wish they were more communicative. Which is maybe a weird thing to say, because YouTube comments are not a happy place overall, for female creators in particular. But there are times when you spend a whole lot of time and effort on something and you put it out there and it’s like crickets chirping and you wish you knew how people felt about it.”

Some described the dialogue with their audience as a motivation to continue creating content:

“Kept going because of the feedback that we got”

“Trying to delight people”

“We’re all attention whores”

More will be explored on participants’ use of comments below.

Divisiveness toward view count and other metrics

One of the defining features of YouTube is its publicly viewable metrics of impact. Sitting under every video—more prominently than any other piece of video information than the title—is the view count. This, of course, differs radically from the availability and treatment of such metrics for science communicators working in other eras or other platforms. In the traditional media era for example, perhaps the closest metric was overall sales of the newspaper—a column in the *New York Times* was, of course, likely to be read much more widely than a column in the Far North Queensland *Tablelands Advertiser*—but precise metrics beyond that would be difficult to know. Was a columnist’s article this week read more widely than last week? Was one columnist more widely read than another?

Even today, the developers of web communications platforms have followed a variety of approaches to the provision of metrics of impact. Some, for example, provide content producers metrics on an internal platform, but don’t offer that information to a public audience. *The Conversation* provides an example here. Others—such as Instagram—have moved away from prominent and explicit display of social likes. Interestingly, there is growing research suggesting these publicly viewable numbers influence how we perceive the content we are consuming (see [Seo et al., 2019](#)), and what

producers produce (Nguyen, 2021). But how do prominent science communicators working on YouTube feel about view count? What do they actually use to measure their success and impact?

View count

Participants offered a variety of stances on video view count as a measure of impact. Many, of course, saw it as a highly meaningful measure—something they looked at to judge success, and something they explicitly aimed for:

“Count would be the primary metric. That’s pretty much the only metric.”

“I think I do orient myself toward view count or clicks. I think that that’s a good metric easily attainable for me to understand whether a video is doing well.” “Umm I don’t want to say views, but I know it is viewership”

“So, of course, views are part of that, you know, I think that they’re a really good heuristic for whether or not people liked a video whether or not they shared it.”

“I’m certainly trying to get as many views as possible, of course”

“Um, I think about it a lot. Because I think it’s a direct representation of your impact, and also your value.”

But others offered a more ambivalent position. Some considered views to be a useful but imperfect measure:

“Views is a really good sort of yardstick... but that is skewed a little bit by the YouTube algorithm... so you can’t judge it by views. I can also judge it by shares on other social media”

“View count does tell you that, you know, it’s being viewed and so you know that it’s going to be a successful video, but it won’t necessarily tell you the quality of it or the accuracy of it.”

“I don’t think it’s real. I think it’s inflated for some people; I think it’s deflated for others.”

Along these lines, some would include the view count in amongst a suite of measures:

“View count is important to a degree... however, view count isn’t the be all and end all”

“So I do want to see high view numbers. I also want to see long watch times. I want to see positive comments. I want to see all of that”

And some indicated they actively ignored or rejected video view counts:

“I don’t like looking just at the numbers, I think that’s definitely a trap with YouTube”

“Tend to prefer engagement types of metrics as opposed to just raw views”

“I try not to think about it honestly. Because I realized that if I derived my self-worth from that number, then I’m going to change what I’m trying to do. And it’s going to change the authenticity of what I’m doing.”

Interestingly, some explicitly mentioned the way that view count will skew the perception of a video amongst an audience:

“I think view count is important to a degree, because people will look at videos and might choose not to watch them if they’ve got a low view count.”

Some also—flagging the discussion on working in the algorithm below—pointed directly to the fact that the view count was an explicit platform choice:

“The platforms, such as YouTube and TikTok, they kind of put it in your face. So whether you’re a viewer or a creator, it is very front and center. So I think even if you did not care at all about view count, you cannot... miss it. Like, even as a viewer. Like here’s how many other people have watched this, which is a weird thing... because most media isn’t like that. You know, when you buy a book, it doesn’t say how many sales you’ve got. When you’re watching TV, I’d say how many people are watching it concurrently?”

Other metrics

Alongside view count, what other metrics did these science communicators use to assess their impact? Participants pointed to a number of metrics they found valuable. Audience retention and watch time were often listed as important (see Altman and Jiménez, 2019):

“I do use... audience retention graphs”

“Significant percentage of watch time”

“Audience retention right through to the end of the video”

“Watch time”

Similarly, many liked to use information on sharing:

“People sharing my content”

“Social media shares”

“Number of shares on different other social media sites which bring in more traffic”

“I try to lean toward shares. Because I think personally, that the clicks mean a little less to me than somebody saying that they shared it with a classroom, they shared it with a friend, they... [saw it as having] value, enough to share it with another person. That to me is much more valuable than just a random view count or a random click.”

Others used the likes/dislikes ratio, but this was not unanimously agreed on:

“Likes and dislikes”

“The likes and dislikes and stuff a lot”

“I used to think views likes, but not that much lately. [Now I’m] on the comments boat.”

Some pointed to other details, such as the gender split on a particular video:

“But also, I look at the gender split on a video too. And I think a measure of success of my videos are necessarily the ones that have broken out of the algorithm, sort of self-fulfilling loop that YouTube has, and has reached a more female audience.”

Others pointed to the value of offline interactions:

“Letters from parents, people building stuff.”

“Anecdotal feedback”

“When people meet you, and they know you as the guy that taught them that thing, but they don’t know your name”

Others pointed to being noticed by—or breaking out of—the algorithm as a sign of success:

“I think videos have [performed] really well if all of a sudden the ... unsubscribe people are in the majority, you can tell ... that the YouTube algorithm has decided, oh, yes, people who’ve watched this video will also like this video, I’m going to show it to more people.”

“And I think a measure of success of my videos are necessarily the ones that have broken out of the algorithm.”

But many—perhaps all of our participants, and often numerous times—stressed the value they got from comments. We turn to this next.

The value of comments

Participants continually stressed the value they gained from comments. Whether in how they sought to understand the impact of a video, in how they sought to improve their work, or in how they saw the relationship between themselves and their audience, participants stressed that comments represented a key vehicle for informing their thinking. This—as noted in part above—highlights a difference between the thinking of these producers and wider discourse about comments online. For many, comments (and in particular YouTube comments) are seen as a toxic cesspool. Our participants recognized that, but still sought the pearls in the muck.

Thus, many stressed that comments were highly valued, and represented crucial data for understanding the impact of a video:

“But the thing that I think I focus on more is the comments... how do people feel about it”

“Qualitative data we get from just comments”

“I’m more about the comments”

“I always keep a pretty close eye on the comment section”

“So I think the comments are much more powerful”

So what were they looking for in comments in particular? Positivity was one key component:

“And the comments are really positive, and that’s been useful”

“Whether their comments are overwhelmingly positive or if they’re negative”

But others went further, suggesting it was the thought that counted, that they were looking to spark deeper engagement with their content:

“The quality of the comments. So I have had some videos with just the general standard of the comments is excellent, like, thoughtful, responsive, watched it, take it all in.”

“One thing I think is the very best is when I get comments on the video, that are asking higher level questions about the content”

“A lot of thoughtful comments coming in”

“When I get positive feedback from viewers like when I get comments from people saying that ... this was really interesting, hey, I learned something new. Because for me, that means that they took time to engage with the material”

Others expanded on this, suggesting the comments represented a way to gain an external sense check:

“It’s comments. I will say that it’s definitely comments. It’s seeing that students are saying that it made sense to them.

“I felt like if I could explain something to somebody else, and that meant I knew the subject really well. And also YouTube was the scariest place I could do it. And because people would comment if I was wrong. So that’s why it went right.”

Finally, some suggested that a deep impact with a small number of viewers—potentially evident in the comments—might be of more interest than a shallow impact with many:

“But in terms of success, there’s different ways, because sometimes you could have, you know, hit on something that ... resonated with one person, for example, and made them realize that physics was something that they really want to do”

This idea—of the impact they were seeking—we turn to now.

Orientation toward impact

So, what are prominent science communicators working on YouTube seeking to do? A simple answer to this question might say “earn a living” and “communicate science”, but given the prominence of this group of communicators, it is essential to consider more deeply how they think about the impact of their work. Indeed, others have suggested science communication research should avoid consideration of just “easy” impacts, such as knowledge transfer or raising awareness, in favor of personal micro-impact or deeper impacts on research, innovation, governance, and institutions (Fogg-Rogers et al., 2015). To address this question, we asked participants if they were more interested in knowledge, attitude, or behavioral outcomes amongst their audiences. More tangibly, whether they wanted their viewers to learn new information, shift a perspective, or change a behavior as the result of watching an online video.

On this, many participants identified impact in terms of knowledge outcomes.

“Educational, first and foremost, that was always my goal”

“Are they . . . a little more informed?”

“Stickiness . . . sometime after watching one of my videos, someone’s like, I learned this cool thing, let me tell my roommate about it.”

“Learning something new”

“Most focused on knowledge on just providing them with that information”

“It’s the learning outcome”

Other participants defined impact as shifts in attitude and perception, many saying they aimed to change people’s minds and thinking:

“Impact is changing people’s minds”

“If I’ve changed the way someone thinks about something”

“It would be the attitude I want to show people why certain narratives are false and why they might have fallen for them. And then if they can recognize that in themselves, then they can change their worldview a little bit.”

“Impact public perception of science”

“I think the thing that I’m hoping for is to shift that attitude because you can build knowledge and not give a shit about what you built”

“The goal, the outcome, is to change their attitude toward science to think science is actually a cool subject”

“I would rather have someone have an attitude shift, rather than remember, this specific thing about a copper mine, or something along those lines?”

Other participants reported actively wanting to change the behavior of their audiences, in terms of promoting vaccine uptake or water conservation.

“They either change a behavior, they think about their behavior differently, maybe they externalize their thought about that behavior, hey, I was, taking a 10-min shower, and then I realized, Oh, I’m wasting a lot of water, maybe I’ll try and take less than a 10-min shower”

“Being able to take something away from my video and use that in their life . . . like somebody saying that they took the vaccine, or they felt more comfortable taking the vaccine”

“Change a behavior . . . think about their behavior differently”

“One of the biggest ways that I measure impact is through comments that people have left me about, “Oh, I didn’t realize that before. And now I’m going to go do XYZ” . . . I’ve had a lot of comments over the past year that people got the vaccine because they watched my content, or they felt more comfortable doing so because they watch my content. And that, to me, is the whole point, that’s why I don’t just talk about this to a blank wall.”

However for others, behavior change was not considered or indeed actively avoided, with some participants stopping short of wanting to influence choices, practices or behaviors:

“Behavior change is not something I want to focus on”

“I’m not trying to influence people in any way, other than to help them make the observations. And I leave the decisions up to them. And I just want people to be armed with the information.”

“I have no real explicit behavioral change that I want them to necessarily do. Other than approach the world with a sense of, you know, things are here for a reason that well, it’s been designed people have given the thought into this. So that said, probably learn things.”

“Some people are trying to make more activists like videos, where they’re trying to get people to buy into something . . . my goal is to make something that is pleasing, right like that people feel like they got something out of it, and it was worth their time.”

Overall, when asked how they defined impact, the majority of participants spoke of the audience. However, when participants were asked about their motivation to create videos or definition of success, many participants reflected on themselves.

Prioritization of intrinsic factors

Motivation to create content

Participants described their motivation to create content in two broad categories: in terms of intrinsic and extrinsic motivations. The majority of participants indicated that they were intrinsically motivated, whereby activities are engaged with for enjoyment, inherent interest or curiosity (Ryan and Deci, 2000). Some indicated an enjoyment of creation and learning:

“I do it because I enjoy it”
“I enjoy learning”
“I’m curious about the world”

Others emphasized the gratification provided by a creative outlet:

“I like the kind of creative outlet of the whole thing”
“Personal satisfaction and creativity”

Indeed, many participants expressed a personal satisfaction in sharing, educating and storytelling:

“I love helping people understand things and understand things in new ways”
“I’ve always loved sharing what I learned”
“I’m excited about telling those stories and helping to educate people about those ideas”

A subgroup of participants indicated that they were extrinsically motivated; where activities are engaged with for reasons other than one’s inherent satisfaction (Ryan and Deci, 2000). Financial motivations were the main extrinsic factor identified by participants:

“Obviously the first reason is money. Just trying to make a good living”

Overall, the majority of participants framed learning, sharing, and maintaining a creative outlet as psychological needs for themselves. These needs underpinned motivation, and were discussed above and beyond the popular, and more extrinsically focused, motivational model of YouTube: such as subscriber counts, view counts and revenue opportunities.

The motivations reported by participants were more akin to artists, rather than motivations described by professions that may appear more similar to that of Science YouTubers, such as teachers (in fact, 45% of participants identified as working with students in educational roles, such as teaching, tutoring, or science outreach, before starting their channel). Research on motivation of artists reports *inner drive* as the most frequently cited reasons of why artists pursue art making: *“I felt compelled to do creative things”* (Daniel, 2018). Teachers are more likely to focus on students, reporting that they are motivated by working

with students and imparting knowledge to students (Han and Yin, 2016).

Interestingly, a career as a Science YouTuber draws many similarities with Petrides and Fernandes (2020)’s career model for visual artists: it entails entrepreneurial and marketing skills, brand creation strategies, and reputation management (see also Bishop, 2022). All of which require reflection on the *self*, rather than reflection on the student or audience. Awareness of self and prioritization of intrinsic factors continued in participants’ definitions of success.

Definition of success

Success in science communication is difficult to define, and may vary widely from project to project and from communicator to communicator. Given that video metrics have been analyzed as an indicator of popularity (Welbourne and Grant, 2016; Huang and Grant, 2020), it was surprising that many creators diverged from defining success in terms of view count or engagement rates. In fact, many used personal enjoyment as a measure of a successful video:

“Main metric I use is... do I enjoy it?”
“We had a lot of fun making it”
“Did I get to do something cool?”
“If they’re kind of enjoyable to put together”
“If I enjoyed it, and I learned, and I have an aha moment”
“Ones that I’m really quite proud of... that I personally enjoy”

This reflects thinking that evaluation of science communication is dependent both on goals and the communication medium (Cooke et al., 2017). Given that many motivations and goals of participants were intrinsically focused, personal enjoyment is a fitting measurement of success. Furthermore, the focus on personal enjoyment may be a more predictable measure considering the relationship of Science YouTubers to the medium of YouTube: they work in an algorithmic workplace.

Working under the algorithm

In discussions of YouTube (or, indeed, any large modern social media platform), “the algorithm” looms like an Old Testament God: unknowable, ineffable, capricious—but definitely all powerful. As many have reported before, social media content lives and dies—and social media producers live and die—on the surfacing decisions of our various algorithmically curated feeds. In this section we explore how our participants responded to the algorithm; like other answers, participants held a variety of views.

Many, of course, stressed the importance of the algorithm in their work, and how much they thought about what the algorithm valued:

“I think about it a lot... understanding how that system works is integral to being able to have a long-term career success, financial stability”

“Whether you like it or not, is something that you do have to accommodate”

“It’s important, the way the platform works. That’s kind of how people find things”

Probed on what the algorithm offered, many pointed to it being an integral part of getting their content out to potential audiences:

“We... care about the algorithm because we want people to find our videos”

“The most important thing is reaching the unreachable. And that’s where the algorithm shines.”

“It allows you to reach an audience that you wouldn’t have been able to reach otherwise”

“I think about the algorithm a lot... I don’t think that helps me make better content, I think it might help my content get viewed”

“If you want them to be watched, you need to cater for the algorithm”

What did this mean in particular? Prosaically, it meant making title and thumbnail choices that would be more likely to be surfaced:

“For me, it’s looking at the click through rate for my thumbnails, so making sure that the thumbnails are something that people want to click on the title as well. I think those two things are a big part of the algorithm.”

“When I think about the algorithm most is, you know, is this title interesting, does this thumbnail look captivating? I think about the algorithm a little bit in regards to length.”

Yet some participants reflected a far more ambivalent position; perhaps that it was an enigma:

“It’s out of my control”

“It is still very much a black box that I think everyone’s trying to work out”

“There’s some things I won’t do that I know the algorithm would like.”

Or more stridently, something to be ignored or perhaps avoided in their work:

“I don’t really think about it”

“It matters very, very little for certain types of channels... I’m not trying to really reach a huge new audience”

“I’m playing a very different game. I’m not playing the algorithm game. I’m not trying to win YouTube. I’m just doing what genuinely interests me.”

“I mean, if I wanted to be more successful on YouTube, then yes, but I’m rather cynical and jaded when it comes to the algorithm on any given site at this point, because I think, especially for someone who wants to do good educational content, that those algorithms are stacked against us. Like what the algorithms reward is not good quality educational material.”

“I don’t think about it anymore. I used to, but I, it’s a black box.”

But when it came down to it, other participants pushed back against this view, suggesting it was the very essence of their work:

“The algorithm, it’s like, annoying, and people have all kinds of bad things to say about it. But like, it’s my job to chase it and figure out how to optimize for it... It’s like, no one is too good to chase the algorithm. It’s your job.”

Discussion

Our goal in this study was to understand the motivations and experiences of popular Science YouTubers, considering their content, audience, and perceptions of success and impact. Our findings suggest that Science YouTubers relate to their audiences three dimensionally: in terms of demographics, values and embodied place; and that impact is viewed largely in terms of transferring knowledge, rather than attitudinal or behavioral change. A persistent theme was the divisiveness toward view count, subscriber count and role of the algorithm, where comments and qualitative feedback from audiences were highly valued. Another important dynamic is how Science YouTubers viewed success, with an emphasis on intrinsic factors, such as personal satisfaction and learning. At both a theoretical and practical level, our results reflect novel areas of interest to science communication students, researchers, and practitioners. Specifically, science communicators may find it fruitful to recognize that audiences can be framed beyond demographic terms, consider attitudinal and behavior change goals, and approach measures of impact more thoughtfully. At an educational, practical and societal level, success may be discussed in qualitative or goal-based terms, rather than view or subscriber count. Furthermore, deficit model thinking is present in informational videos, and emotional valence can be inserted through personal stories and perspective.

Here we dwell on two areas in particular: deficit model thinking in popular science communication work, and the impacts on creators of working in an algorithmic workplace.

The deficit model

It is worth reflecting firstly that many of the participants of this study, in framing their motives and goals to create content, revealed somewhat of a deficit model approach to their science communication thinking: that providing knowledge about a scientific topic will lead to either more positive attitudes to science, or behavioral changes in line with scientific thinking.

We can see this articulated clearly in the ways participants spoke about impact, and the pathways they saw for achieving that impact. Many saw impact purely in knowledge terms—providing good clear explanations that students could use in their studies. These people can be excused from this discussion. But others talked of impact in attitudinal and behavioral terms—as changing people’s minds, changing perceptions, or changing behaviors. These are all, of course, legitimate goals. But many assumed that the pathway to achieving them would be *via* resolving a knowledge deficit. We heard phrases, for example, speaking of the value of debunking:

“I can also have the greatest impact on public perception of science so I can debunk hoaxes and con men and sort of you know, fight against misinformation.”

Perhaps this is understandable—almost by default, YouTube is a platform that is good at providing information; most science communication on YouTube begins and ends with stories of science or explanations of scientific facts (see Huang and Grant, 2020; Debove et al., 2021). Successful communicators make this fun or engaging or emotional (in fact this wrapping appears central to the work of successful communicators) but nevertheless, information is very often at the heart. We can perhaps contrast this with the science communication we might see on Instagram or TikTok, which is perhaps far more naturally oriented to aesthetics, tone or attitude. It might also be the case that many Science YouTubers shy away from explicit attitudinal or behavioral arguments, perhaps so as not to limit their audience, or to put bounds on their already highly personal work.

Hence we are not arguing that YouTube science communicators should radically change their practices—the platform privileges information, and many viewers want it—but perhaps to recognize the limits to which the provision of information can change attitudes or behaviors. In contrast, if science communicators are seeking to use YouTube to influence behaviors or attitudes, then perhaps other strategies are warranted: Including framing content with more emotional valence, taking steps to understand the audience’s needs and facilitating two-way communication.

An algorithmic workplace

Secondly, participants revealed that platform metrics and consideration of the YouTube algorithm influenced them in myriad ways: shaping the nature of their content, their personal value, and experience of success. Tackling the algorithm loomed as a key challenge of our participants’ professional lives. Like other modern professional content creators, Science YouTubers exist in what might be called an algorithmic workplace (in contrast to a marketplace), where popularity and income are shaped by sometimes unpredictable technological controls.

The experiences of Science YouTubers reflect two theoretical approaches to platform labor: the experience of job insecurity or precarity (see Standing, 2011; Duffy et al., 2021), and the influence or control of algorithms (Vallas and Schor, 2020). Participants voiced a range of concerns within these approaches: that thinking about the YouTube algorithm was “a trap,” that the algorithm was also crucial to their success and financial security. A range of approaches is expected: within an algorithmic workplace are different uncertainties, with significant uncertainties in terms of payoffs (in this case, view count and income) affecting some creators more than others. Differing experiences of platform labor workers is in line with previous research. Analyses of platform companies such as TaskRabbit and Uber found that worker satisfaction, autonomy and income can vary significantly within platforms (Schor et al., 2020). In contrast to platforms such as TaskRabbit and Uber where worker income is more normally distributed, workers using YouTube are influenced by power law dynamics: where a class of popular creators are established, akin to celebrities. Considering this class, the economics of science communication on YouTube remains an unexplored area: particularly considering the influences of race, culture and gender in income disparity potentially accentuated by algorithmic influences.

In reflecting on measures of success, some participants mentioned platform metrics such as view count and subscriber numbers as key measures. To this end, there was an emphasis on algorithm-based decision making, where participants spoke of engaging in popular trends to increase click through rates and viewership. It is understandable, if not expected, that participants would consider metrics—the prevailing measures when working within an algorithm. However, this was explored more deeply as some participants equated view count with personal value:

“Um, I think about it a lot. Because I think it’s a direct representation of your impact, and also your value. Like, I am just a product that can be sold to sponsors.”

However, many participants voiced a need for comments and qualitative feedback, and also demonstrated an aversion to

view count. Participants tended to prioritize intrinsic factors: creating content to satisfy their own enjoyment and desire to learn. This may be a coping strategy in an unpredictable work environment: where view count can vary greatly from video to video.

It is fruitful to consider what “success” means for both current and emerging science communication practitioners where there is no upper limit to how many views a video can receive. Entering the algorithmic workplace is akin to running on a football pitch with continually shifting goal posts—when does one actually kick a goal, and does the match ever end? Some Science YouTubers attempt to shift the goals in locations that suit them. But the influence of infinite metrics—and the algorithm—loom over this decision making. Perhaps they could score more points if they just ran a little further. The experience is akin to others in platform labor, an Uber driver waiting for a surge; or in unpredictable workplaces, an actor waiting for her breakout role. As Swanson writes in *The Anxiety of Influencers*, “The angle of our pose might be different, but all of us bow unflinchingly at the altar of the algorithm” (Swanson, 2021).

Limitations

This study is the first to provide an in-depth perspective of the motivations and impact perceptions of Science YouTubers. However, we do acknowledge some limitations of our study. Results may be limited by inclusion bias, and due to this and the qualitative nature of the study, findings may not be generalizable to all Science YouTubers, those in non-English speaking markets, or science-focused content creators on other social media platforms. Furthermore, our results may be limited by social desirability bias, where more favorable aspects of content creation may have been emphasized (e.g., teaching or helping others, or declarations of being “in it” for intrinsic reasons) rather than financial incentives. Nevertheless, this study can serve as the basis of future research and practical initiatives: Future research could examine motivations and perception of impact in popular science creators on other platforms, such as Instagram or TikTok, to build a deeper understanding of this highly influential group. Practically, science communication initiatives should consider how Science YouTubers can be supported to pursue deeper attitude or behavior change objectives, either in terms of resources or expertise.

Conclusion

This study highlights how an influential group of science communicators, Science YouTubers, consider their audience, as

well as the impact and success of their content. Findings can guide how science communication students and practitioners think about audience, consider how the deficit model is reflected in informational videos, and how the algorithmic workplace may influence science and educational content.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by ANU Human Research Ethics Committee. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

Author contributions

VH conceived the study. VH and WG designed the study, analyzed the data, and drafted the initial manuscript. WG, MM, and IS conducted the interviews. All authors drafted the interview guide and provided feedback and approved the final manuscript.

Conflict of interest

Author VH runs an educational YouTube channel, where videos receive advertising revenue from YouTube.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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