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Does the production value of a short science video hosted on YouTube influence how much the desired audience is likely to enjoy and engage with it?

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Abstract

This thesis continues the research of Welbourne and Grant (2016) within the field of science communication on YouTube, by following the study that Figueiredo, Almeida, & Benevenuto designed to evaluate whether content factors determine YouTube video popularity (2014). This study experimentally evaluates whether the production value of a short science video hosted on YouTube influences how much the desired audience is likely to enjoy and engage with it.

Science communication is an increasingly significant area of research and practice, relevant to all aspects of science and technology. Scientists are increasingly expected to publicly share their work with the public, therefore it is important to understand the best ways to get these messages to their target audience. YouTube, the most popular video-sharing network, was created as a user-generated social network, however in recent years professional organisations have been able to contribute too. Resultingly, there is a divergent style differentiation between professionally generated content (PGC), and user generated content (UGC). In this study, two near-identical pairs of videos consistent with the science communication genre were created to imitate PGC and UGC YouTube channels respectively. A survey (n=900) was conducted on Amazon Mechanical Turk where participants were asked to watch one PGC and one UGC video, and report on which video they enjoyed, would share, predicted would be more popular and found more reliable. They were asked which channel they would like to watch again. A Pearson's chi^2 test found statistically significant preference to enjoyability and shareability for the UGC videos, but no preference between production value for predicted popularity. Surprisingly, participants opted to watch a PGC in the future, despite the overall preference to UGC. This study directs specific attention into the rapidly-expanding landscape of online video, and its relevance to videographic content creators within the realm of science communication.

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It was a scary decision for me to enrol in a Masters of Science Communication two years ago. At the time I was half-way through completing a Masters in Marine Science at Otago, and it would mean abandoning the work that I had already done. However, I am so grateful to my previous supervisor, Dr Chris Hepburn for supporting my decision to change my path of study and to my parents for encouraging me to take this plunge. Without their support I don't know whether I would have made the change into the field of Science Communication and been able to realise where my true passions lie.

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I. Introduction

Personal introduction

The seed of the idea for this thesis started with my Mum. Forever telling me "never believe everything you see on the Internet" when I exclaim something new that I've found out, it got me thinking. Whilst I agree, that many-a-thing you view on the Internet is not true, I pondered whether there was a generational difference between how credible we perceive different sources of information to be.

For me, turning to the Internet is an obvious choice when I'm looking for an answer. There are certain websites that I know I can rely on more than others, or sources that I trust more than others. I can search through the insurmountable Internet hits more efficiently than my Mum can, partly because I am more familiar with reading the context of a website or video clip to gauge how much I should trust that source. I'm not only taking into account the web-page itself, but the font, colour scheme, logo, layout and choice of images used. I compile information from all of these factors to make my decision.

However, my Mum is more sceptical of the Internet in general. She prefers to talk to a knowledgeable person or find the information in a book. Mum is less familiar, perhaps, with what sort of things might indicate that a web-page is or isn't credible.

As a student in documentary filmmaking, I wondered how this translates to videos on the Internet. I often turn to YouTube as a source of information, to watch tutorial videos or to get better grips at a tricky concept. Often these videos are made by hobbyists who have channels where they can share their knowledge. For me, as a *person*, I hold these sources with relatively high regard. However, for me as a *filmmaker*, I can't help but wince at a lot of these videos - often breaking all the rules that you first get taught when it comes to filmmaking. Jump cuts, bad audio, talking directly to camera, shaky camera…the list goes on.

Now, I *know* that these videos aren't intending to be ground-breaking as far as beautiful cinematography goes, but they most certainly hold my attention and, as an information-seeker, I don't hesitate to listen eagerly.

So I wondered, does it matter? Is there a difference between how highly we regard the information based on how we are being delivered it, and which one is a more effective method of communication?

Perhaps the 'BBC' high-production-value documentary style that we're used to isn't *always* the best way to get your message across, especially if you're using the Internet as your medium to communicate. Furthermore, perhaps modern audiences are becoming more tolerant and accepting of an informal less-polished style.

With more technology available for amateur filmmaking than ever before, can the 'pro-amateur' compete for an audience with the 'big dogs' of documentary film from the comfy confines of their bedroom? And if they can, does the narrowing-gap between professional and amateur stylistically influence the future of scientific documentary film?

This thesis is just a tip of the iceberg in experimentally exploring some of these questions.

Creative component short introduction

Prior to coming to the Centre for Science Communication, I was studying marine science. Whilst I loved the research I was carrying out, I always had a nagging feeling in my gut that my energies might better be spent by communicating to others *why* doing scientific research is so important and interesting. When I switched into the field of science communication, I was less hands-on with carrying out the science itself and began learning about how to craft engaging narratives surrounding the science in order to communicate it better. However, I never lost interest in my first love - marine science. Consequently, I've always found myself drawn to telling marine-related stories but have been able to expand and spread my marine knowledge far further than the niche topic I was studying previously.
It was through some academic peers of mine, who also share a soft spot for the creative arts, that I was introduced to the Art and Oceans Exhibition. This project (a great example of science communication in itself) facilitated collaborations between marine scientists and artists with the goal to creatively express the diverse areas of the contributing scientists.

For me, a science communication student with a passion for marine science, the opportunity to make a film *about* people communicating marine science was a no brainer. This is what led me to meeting Kalinka Rexer-Huber, a seabird biologist, and Tori Clearwater, a sculptor and artist.

The creative component of this thesis is a 25-minute documentary film, Hooked. The film explores threats to Southern Ocean seabirds through the eyes of Tori as she develops a sculpture of a white-chinned petrel in response to Kalinka's PhD research.

Considering the film's length, and hard-hitting messages, I decided that it would be most appropriate to create this film with a high production value. I knew that the visuals required to tell this story in the way I envisioned it would be difficult to achieve without the use of a high-quality camera, tripod and sound recording system. My research, especially at the time of conceiving the film idea, indicated that low production value films tended to be more informal, and I didn't want the production value of my film to detract from the strong underlying environmental messages that I hoped my film would communicate. Additionally, as my film is not intended for YouTube I thought it less appropriate to make a low production value film.

Academic component short introduction

This thesis aims to experimentally evaluate whether the production value of a short science video hosted on YouTube influences how much the desired audience is likely to enjoy and engage with it.

Production value is an amalgamation of the many factors that go into producing or creating a video. The quality of camera used, how well lit the video is, the quality of the sound and whether it has been filmed handheld or with a tripod are some of the tell-tale indicators of either how professional or unprofessional a video is. A more professional-looking video will have a high production value, whereas an amateur video is more likely to have a low production value.

With widely available technology to produce and distribute videos on the Internet, videographic content is becoming an increasingly prevalent. In the field of science communication, video is increasingly being relied upon as an effective method to communicate to the desired audience. The creative component of this thesis uses film to communicate about some of the issues surrounding commercial fishing and bycatch of seabirds in the Southern Ocean.

This thesis will first review current literature and introduce the topic of science communication, its value to society and platforms that its most commonly distributed. I will discuss how the landscape of video production has changed through time, and its influence on science communication. I examine how video can be used to enhance traditional communications and how it may be used to do so even more so in the future. I address where there are existing gaps in knowledge and identify how this thesis may contribute to current understanding, outlining the core aims of the experimental study.

In the methods, I will introduce the rationale and procedure used to answer the thesis question experimentally, and then go on to present the results of this experiment. Finally, I will discuss the findings in relation to previous literature and within the wider context of science communication, and close with a look to how this research is relevant to science communicator videographers.

II. Literature Review

What is Science Communication?

> ***"It is time that key scientific institutions invest in evidence-based science communication and engagement with the same fervour, rigour and commitment to excellence that they bring to curating scientific research itself"***
>
> (Lohwater & Storksdieck, 2017).

Traditionally, scientists have communicated their works through academic publications and spoken word (Trumbo, 1999). These methods of communication tend to have a limited audience consisting of other academics or educated science-seeking adults. Furthermore, the specific jargon used in many scientific journals are often incomprehensible to your average educated non-professional (Shortland & Gregory, 1991)

There has long-been an argument that public awareness and understanding of science is integral to the development of a modern democratic community (Tobey, 1971). In the early 1900s, scientists such as Slossen, Heyl, Millikan and Hale argued that human potential could only be met with the incorporation of science. "The ascent of man" a term coined by Bronowski (1973), a deliberate play on Darwin's "the descent of man" (1871), encompasses the ideas that embracing science is fundamental to the evolution of modern, industrial, self-critical, tolerant and democratic societies.

"'Science' comprises not only the biological, life, and physical sciences but also the social and behavioural sciences and such applied fields as medicine, environmental sciences, technology and engineering" (Friedman, Dunwoody, & Rogers, 1986).

With such a broad expanse of topics under the umbrella of science, it is vital that non-scientists can understand distinctions, should they desire. Moreover, they should be able to recognise the need for science, and have, at least a small, appreciation for its central role in modern life.

"In an era of unprecedented technological and scientific advances, many of which have the potential to radically change human existence, science news is important." (Weigold, 2001). However, the methods used to communicate science news to the publics are broad and vary depending on the audience. It is advocated by some that the modern scientist has a moral responsibility to interact with the publics about their research (Davies, 2008; Cronin, 2010). However, some scientists hold the fear that their research may easily become warped or misunderstood via mass communication as they often presume that their results require a significant level of prior intellectual understanding of the topic, an impractical expectation of a mass audience (Shortland & Gregory, 1991; Weigold, 2001; Porter, Williams, Wainwright, & Cribb, 2012). In the 80s, some argued that scientific messages are wasted when disseminated to the general public (Prewitt, 1982; Miller, 1983). However, the ubiquity of mass media has changed how messages are conveyed to the media, and Sommer's longitudinal study on New Zealand scientists and technologists showed that there is a growing appreciation among scientists for their responsibilities to communicate science to the public (2010).

Even so, science communication through mainstream journalistic reporting remains a contentious issue from both parties' perspectives. "Journalists may view scientists as narrowly focused, obscure and self-absorbed. Scientists are specialists, involved in the minutia of a specific problem that may represent a small piece of a much larger puzzle…This can make it difficult for them to state why their most recent discovery is a newsworthy event or even significant development. Scientists offer predictions that are tentative and qualified, which may seem incompatible with fostering excitement in a story." (Weigold, 2001). Journalists may be wary and rightly sceptical of scientists who are overly eager to share their results, suspicious of ulterior or political motives (Russell, 1986; Allen W. , 2001).

Nonetheless, imparting scientific findings, especially those which influence policy is a responsibility. Furthermore, the public should know about research that may influence their wellbeing or involves areas of risk: health threats, medical developments, natural disasters, environmental changes for example (Weigold, 2001), despite any preconceptions about 'science' and 'scientists' in general. Modern coverage of science comes primarily from mass media: newspapers, television and online. However, in this context, science competes with many other news topics for a relatively small amount of space and time (Weigold, 2001). There is often very little room or place for thorough explanation of the context of the story (Seigfried, 1992). Competing media outlets will put emphasis in different places, and on different topics depending on their target audience or political orientations that can dilute or confuse the message (Burkett, 1986). Television and the Internet are the most popular sources for science news and information (Horrigan, 2006). We are heavily influenced by the media that we consume (Gerbner, 1987; Logan, 2001), but as a result, may gain unrealistic perceptions of what science or scientists are. Popular television shows like 'Rick and Morty' or 'Grey's Anatomy' have scientific groundings, but do not portray a realistic impression of science or scientists. Ironically, it's the people who engage in these shows with the assumption that they are engaging in science, are perhaps the people who need to be targeted with effective science communication the most.

The Deficiency Model (Ziman, 1992) describes the pattern in which scientific findings are transferred from knowledgeable experts to unknowledgeable public in a top-down manner. It highlights the danger of ignorance of science in a democratic society, where without a clear distributor of scientific knowledge adult non-scientists are vulnerable to believing untrue messages. However, Gregory and Miller (1998) and Trench (1998) critique this model, arguing that there is often a lack of a unified message from scientists, so top-down communication could lead to greater distrust from the public and aversion to science. Bauer et al. further discuss limitations of public understanding of science (PUS) in relation to the deficit model, and how new contextual frameworks are necessary for furthering this research area (2007). With the advent of the Internet, scientists and organisations are able to instantaneously communicate directly with audiences with no mediation (Weigold, 2001). Trench (2008) argues that the science communication 'deficit model' has shifted to a 'dialogue model' with the change of the millennia, where two-way communication should now be better facilitated directly between experts and the public. This allows for a more transparent view of science and scientists, and the opportunity for the public to drive research questions about areas they are passionate (Trench, 2008).

Still however, the language used in science differs greatly to the language used in every-day communications. Despite best efforts from scientists willing to communicate their research, and willing ears from a public audience, there is often a lack of a common language. Meyer (2010), describes the rising need for a ‘knowledge broker’, someone to create connections with researchers and their desired audiences and bridge the gap. Brokers must construct a common language between scientists and facilitate two-way information transfer (Oldham & McLean, 1997; DeLaet, 2002). These knowledge brokers or science communicators must hold the trust of both scientists and the audience, being able to present abridged scientific knowledge that is both accurate and engaging. Effective practice will reach the previously-unengaged audience (Poliakoff & Webb, 2007).

Watson and Hill identified five common factors within existing successful communication frameworks: the initiator, the recipient, the mode or vehicle of delivery, the message and the effect (1993). “Communication is a process of sharing information with others, it is also a means of sending and receiving messages through a variety of channels”. They recognise the importance of a reciprocal exchange of ideas from the initiator and the recipient. Trench argues that whilst there is a is a shift towards more open ended and reciprocal communication, there is a place for each model of communication, dependent on the situation (2008).

Platforms used for science communication

There are many platforms used to communicate science, depending on the content, context and audience (Burkett, 1986; Weigold, 2001). Newspapers, academic journals and museums actively promote scientific knowledge, whilst magazines, television, the Internet, science cafés, community outreach projects and public meetings are less-formal but equally as informative outlets (Nelkin, 1996a; Nelkin, 1996b; Besley & Tanner, 2011). Public preconceptions about each of these platforms shape how the public interact with scientific information (Gerbner, 1987), and how much they perceive it to be credible (Trumbo, 1999; Weigold, 2001; Varner, 2014). Therefore, it is essential to recognise the strengths and weaknesses of each of these platforms, to ensure the appropriate platform is being used for the desired audience so the scientific message is not hindered. There are many places where or ways in which the public informally encounter science. Whilst these science platforms are often not distinct and inherently intertwined, the benefits and weaknesses of some common informal science learning places will be discussed below. These have been categorised into museums, written articles, online, events and public participation, and visual science communication.

Museums

In general, science museums are thought of as being trustworthy and objective houses of knowledge (Cain & Rader, 2017). Whilst their methods of communicating science have changed through the years, they continually face the challenge of enticing visitors through their doors and reaching members of the public who may not have already planned to enter. Over the years, museum exhibitions have progressed from being largely observational to interactive spaces (Whitcomb, 2006). They have embraced commercial advertising strategies, used professional interior design teams, taken theatrical approaches in their exhibition design and digitally elaborated displays to add educational punch and public appeal (Boylan, 2008; Hein, 2008; Rader & Cain, 2014; Cain & Rader, 2017). Modern museums have embraced digital technology and design so much that questions have been raised about the effectiveness of material objects to communicate, do they still need to display physical objects (Conn, 2009)? However, by embracing a more informal learning environment, they ultimately widen their audience (Varner, 2014).

Written articles

Newspapers, magazines and journals used to be go-to for current information on all manner of topics, including science. Now, these platforms are declining alongside the emergence and dominance of the Internet (Scheufele, 2013). Many print outlets now publish online alongside their physical copies giving them access to wider audience; there is a generational divide where younger people tend to use online sources more, and older people prefer physical (Scheufele, 2013). Mainstream journalism has declining coverage of diverse science topics and tends to focus on 'big' science which drives policy or is perceived to have a greater public interest (Shäfer, 2017). Newspapers in particular will steer their reporting towards their readers' interests, education level, political agendas and culture (Weigold, 2001), so are often disregarded as a reputable source of scientific information, carrying a heavy bias. Magazines and journals tend to have a narrower focus and dedicated science writers (Burkett, 1986), so are able to delve into more detail of the topics they report upon, in turn are regarded are more reputable sources of information.

Online

Online audiences are inundated with information, however this information is rarely exclusively found online. Instead, the Internet serves as an easily-navigated focal database to access this information. Amid dedicated news sites, institutional and educational webpages, video-hosting platforms and social media sites feature varying portrayals of the same story (Varner, 2014). It is easy for an individual to find information that confirms their own ideology, politics or group identity regardless of the information's truthfulness (Scheufele, 2013). The Internet puts the initiator directly in contact with the recipient, facilitating two-way communication that may not have otherwise been possible (Southwell, 2017) and even allowing the recipient to author their own contributions (Fahy & Nisbet, 2011). However, even if an organisation is publishing excellent science communication, it may fail to reach its audience purely from out-competition, a downfall of the information-rich web. On the other hand, easy information sharing online means distribution of information is rapidly facilitated, which can increase the audience reach organically (Lohwater & Storksdieck, 2017).

Events and public participation

There has been growing demand from scientific institutions for increased dialogue between scientists and the public (Varner, 2014). Hosting public meetings reflects strong commitment to the public (Gastil, 2000), and improves the image of science and scientists in the public eye (Goodwin & Dahlstrom, 2014; Maile & Griffiths, 2014). When addressing serious societal problems, morally or ethically sticky subjects and science which informs policy such as health, environment, infrastructure and the economy, the public voice needs to be considered (Gastil, 2017; Kitcher, 2003). Furthermore, since most science is publicly funded, it is worthwhile to get the public on-side (Varner, 2014).

Public meetings can range from large formal deliberative meetings, information sessions, discussion boards and informal science cafés (Maile & Griffiths, 2014). Face-to-face gatherings are seen to be a more authentic method of communication, that may often result in richer understanding of people's opinions (Mathews, 1999). Conversations fluidly adapt to suit the situation, instead of being bound by pre-determined words in written text (Maile & Griffiths, 2014). Often participants are split into small focus groups in order to discuss the topic in question, facilitating the space for mutual respect between participants that eliminates social pressures, allowing the group to arrive at a considered judgement (Yankleovich, 1991; Gastil, 2000; Gastil, 2017).

It has been debated whether attendees to organised public meetings is a representative sample of the wider public, and consequently whether these forums provide an accurate representation of the collective publics standpoint (Gastil, 2017). Are some groups better equipped to handle scientifically complex issues than others depending on their level of education (Gastil, 2017)? Has sufficient background information been provided to allow the public to consider the topic thoroughly? Is the consensus biased by the *type* of person who attends public meetings in the first place? Despite these pitfalls, public meetings are effective ways to decrease the gap between scientists and the public and foster dialogue.

Visual science communication

Scientists have long-used graphs and diagrams alongside written documentation of their observations or thoughts. The use of visual aids, which often include colour and symbols can add depth to ideas which may otherwise be lengthy to communicate through words (Trumbo, 1999). Visualisation is especially important to enhance the understanding and communication of complex, theoretical or invisible ideas (Gershon, Eick, & Card, 1998). Learning to understand images requires little specialised training. Inherently visual representations are universally interpretable, being intuitive even to inexperienced viewers (Messaris 1994, 1998), and are therefore an excellent tool at a science communicator's disposal. More recently technology has enhanced the visual potential of science: photographs, scans, videos, animations, infographics, and computer modelling can all be used to make the unseen tangible, giving scientist greater power in both understanding and communicating.

Effective science communication must use a blend of these methods to communicate the desired message, in order to maximise the engagement of the audience.

Video and filmmaking in science communication

"We speak (and hear) and for 5000 years have preserved our words. But we cannot share vision. To this oversight of evolution, we owe the retardation of visual communication compared to language. Visualisation by shared communication would be much easier if each of us had a CRT in the forehead" (DeFanti, Brown, & McCormick, 1987).

Whilst we do not have screens in our heads, the ubiquity of modern technology, especially in the developed world, means that each of us have the ability to digitally record the world around us, and share it easily with others via the Internet (Cone & Winters, 2013), or store in digital form indefinitely. In 1975, Ruby predicted that technologies to produce images held great communicative potential. Today, video is widely used as a vehicle for communicating messages in an informal way (Cone & Winters, 2013).

Fish et al. (1990) characterised informal communication, *"traditionally mediated by physical proximity"* as a rich form of social exchange and discuss how it is important especially within a workplace. Social presence theorists also agree that face-to-face interactions form the greatest channels of informal communication (Short, Williams, & Christie, 1976; Bulick, Abel, Corey, Schmidt, & Coffin, 1989), being facilitative of spontaneous idea sharing and helping to develop social networks.
However, the largest downfall of informal communication is that it is limited geographically. Video offers a good substitute for informal communication, augmenting the power of face-to-face communication, making it possible across both

space and time (Fish, Kraut, Root, & Rice, 1992). Moreover, video amplifies the observational powers of the viewer, with sound effects, and close-up shots often used in film to help focus the audience's attention. Film is also an effective way of conveying a lot of information within a short time. Whilst film and video have traditionally been used purely for entertainment, these qualities make them an excellent communication tool, increasingly being used as such by universities and research organisations (Davies & Horst, 2016).

Arguably the most well-known example of science communication within the video and film realm is the wildlife documentary (Dingwall & Aldridge, 2006). Wildlife documentaries typically construct narratives alongside stunning images, in order to reach publics about the biological and environmental sciences (Dingwall & Aldridge, 2006). This genre is fore fronted by organisations such as the BBC Natural History Unit, National Geographic and Discovery, who produce a large amount of wildlife film. Collectively, these broadcast channels garner millions of viewers annually and are internationally distributed (Dingwall & Aldridge, 2006), highlighting the demand for this type of science communication.

Nature documentaries are just a subset of science communication within the video and film realm. Wildlife, educational, instructional, and science-fiction film each fit under this umbrella (Cone & Winters, 2013), on a continuum between factual and entertaining. An effective educational video, according to Brame must be designed to be engaging and interactive for its audience whilst presenting the desired information in a digestible way (2015). Nature documentaries nestle themselves somewhere between being entertaining and educational; Dingwall and Aldridge question whether these two goals (entertainment and education) can coexist without hindering the other (2006). Nonetheless 'factual entertainment' is a huge sector within major international broadcast organisations (Dingwall & Aldridge, 2006). Science-fiction film can often take creative liberties and have been criticised as an effective science communication tool and responsible for blurring the lines between fact and fiction (Frank, 2003). However, as Dingwall and Aldridge point out, science fiction can play an important cultural role by introducing science to a mainstream lay audience creatively and normalising, often futuristic or polarising, concepts in an unconfrontational way (2006).

More recently, with the advent of the Internet and social media possibilities discussed above, an important shift has occurred in the landscape of science communication via video. Online video sharing platforms such as YouTube have facilitated an ever-expanding space for distribution of the aforementioned areas of videograpic science communication (educational, fictional and wildlife), and enabled exposure for non-professional user created content (UGC). This UGC content, now competes with the previously professionally dominated area of filmmaking (Baccarne, Evens, & Schuurman, 2013). Due to these technological advances, online science communication is becoming an increasingly blended space, and the distinction between UGC and PGC (professionally generated content) blurred.

Evolution of YouTube

Living in a "shrinking world" (Allen & Hamnet, 1995), our lives, by on large, increasingly revolve around the modern inventions that surround us. With dramatic advances in technology, transport and architecture life has become easier, especially in more economically developed countries. The technological revolution has shaped our access and attitude to information, particularly within the visual and auditory media realm.

Television sets became commercially available less than 100 years ago, and then, only to a limited audience. Regular viewing of media was only available to a small portion of society across a few channels and production of content exclusively kept to professionals (Isomursu, Perälä, Tasajärvi, & Isomursu, 2004). In the late 20th century personal video cameras became common, mostly used for home-videos as personal computers were not equipped to edit footage. However, quicker, cheaper and more powerful personal computers have co-evolved with higher quality, smaller and more portable audio-visual (AV) devices with large data storage capacities substantially changing the video-making landscape (Lo, Esser, & Gordon, 2010). Now, almost anyone has easy access to inexpensive high-quality AV technology (Isomursu, Perälä, Tasajärvi, & Isomursu, 2004).

Alongside technological advancements in personal AV technology, the invention of Web 2.0 in 1999, has had one of the most widespread impacts of global culture, adding a new dimension to our reliance on technology (DiNucci, 1999). Colloquially called the "information highway" (Lo, Esser, & Gordon, 2010), the Internet has made previously-niche information ubiquitous, accessible and rapidly available. On the Internet, societal income and class barriers are less clear-cut (Juhasz, 2009), with the ability to browse and upload freely. It has connected the world; in fact, many of our social interactions exist purely within the World Wide Web (Castells, 2009).

Among the myriad of websites on the Internet, there are a few giants which dominate. Described by Jarrett as "an heir to the economic and cultural role once played by broadcast media" (2008), YouTube, founded in 2005, sits at the throne of online video sharing platforms (Burgess & Green, 2009). When first created, it provided a space for amateur videos to be uploaded, characteristically being short, humorous and easily accessible (Kim, 2012). This template has become standard for other video-viewing websites following the YouTube model such as Vimeo and DailyMotion (Kim, 2012). However, after being purchased by Google for $1.65 billion in 2006 (Burgess & Green, 2009), YouTube morphed into a video platform not just for amateur users, but also professionals. This both bridged and blurred the gap between amateur videos and professional broadcast television, and also marked the expansion of the television industry onto the web, paving new patterns of television watching (Kim, 2012).

Whilst YouTube continues to pioneer online video, the broadcast television industry has had to adapt (Burgess & Green, 2009; Baccarne, Evens, & Schuurman, 2013). As more and more people turn to their PC's instead of TV's to watch television, there has been a rise of broadcast-backed sites that compete with the instantaneous availability of other Internet content (Baccarne, Evens, & Schuurman, 2013). For example, independent websites such as Hulu and Netflix, which pride themselves on supporting high-quality, quick streaming, and uninterrupted television are now serious contenders.

Previously, the largest issue with the freely uploaded video content on YouTube was copyright infringement. With Video ID technology introduced in 2007 by YouTube, copyright owners had the option to monetise pirated videos, sharing the profits with YouTube (Stetler, 2008). Organisations quickly realised the economic potential in advertisement on YouTube which changed the landscape of video uploads completely. Becoming a serious commercial marketing platform, advertisers were wary of putting their advert next to low-quality home videos, they were not viewed as being commercial-friendly (Stone & Barnes, 2008; Kim, 2012). PGC was promoted over UGC and the presence of an advert became to symbolise a stamp of quality for the video (Kim, 2012). Concern grew among the amateur users about their ability to compete with professionally produced and funded videos for views (Burgess & Green, 2009; Welbourne & Grant, 2016).

Despite its reputation as a video-sharing website, YouTube is, by definition, a social networking site. Social networking sites allow users to create profiles, connect with other users and search among other users' connections (Boyd & Ellison, 2007; Paolillo, 2008; Burgess & Green, 2009). Participants not only passively view uploaded content, but actively participate into the YouTube community via uploading, commenting, liking and subscribing (Burgess & Green, 2009; Lee & Watkins, 2016).

Access to the Internet is becoming increasingly widespread, especially with the prevalence of Internet-enabled smart phones. As a result, users are able to access any kind of media content at their convenience (Cooke, 2005; Ellingsen, 2014). With more content being uploaded per day than could ever be watched (YouTube, 2017), content creators compete for the limiting factor: the consumers' attention (Davenport & Beck, 2001; Welbourne & Grant, 2016). Aside from its comedic roots, YouTube is being increasingly used as a tool for communication, learning and teaching (Hasse, 2009; Rosenthal, 2018).

Traditionally, in the world of scientific documentary film, PGC has taken precedence over UGC. They have the access, equipment and budgets to show and educate their audiences in novel ways and produce high volumes of content quickly (Welbourne & Grant, 2016) unlike lower value productions. Yet, armed with a DSLR and an Internet-connected PC, almost anyone could claim themselves a documentary filmmaker. With YouTube facilitating an open field for amateurs and professionals alike, what do consumers prefer?

Popularity on YouTube

On YouTube, the popularity of a video is measured by user participation: content viewing, likes, comments, shares and subscriptions (Burgess & Green, 2009; Kulgemeyer & Peters, 2016; Welbourne & Grant, 2016). YouTube's recommendation algorithm promotes popular videos to increase their audience reach, and in a richer-get-richer type scenario, these in turn get high user engagement (Szabo & Huberman, 2010; Zhou, Khemmarat, & Gao, 2010; Figueiredo, Almeida, & Benevenuto, 2014). With a vast range of video genres available, online participatory communities exist for all niches of interests: music, sport, comedy, gaming, education, technology and science.

Despite the concern that PGC would overshadow UGC, the largest downfall of PGC on YouTube is being unable to foster meaningful online connections and participation amongst its viewers. The 'perceived credibility of a message depends on the recipient's perception of its source.' (Ergodan, 1999; Mir & Rehman, 2013). From a marketing perspective, it was found that users were cynical of PGC and believe that UGC is more impartial and trustworthy (Cheong & Morrinson, 2008; MacKinnon, 2012). Communicator continuity, a feature typical of UGC and atypical of PGC, has been found to help nurture positive connections with a viewer base (Welbourne & Grant, 2016).

Unsurprisingly, marketing agencies tapped into this, using existing YouTube personalities and channels to promote their products, thus the YouTube vlogger was born. With the high availability of semi-professional AV gear, the production quality of UGC has risen. YouTube vloggers often create hybrid UGC-PGC that can outcompete professional brands in terms of popularity – they are professional amateurs.

Predictors of a video's popularity may be gauged by user engagement, measured by content-agnostic factors such as: video upload time/date, authors' social network, number of views, video age and the number of associated key words (Borghol, Ardon, & Carlsson, 2012; YouTube, 2012). Borghol et al. (2012) evaluated the relative importance of content-agnostic factors and found whilst unsurprisingly the number of views was the strongest predictor of popularity, and the uploaders' social network is also a strong predictor. This reinforces the importance of active participation within the YouTube community to gain popularity. This also highlights the difficulty a new channel faces when attempting to gain reputation and popularity; the richer-get-richer model thrives and overpowers. However, this is not the only measure of a video's success (Burgess & Green, 2009). A channel must host content that is engaging in order to garner engagement in the first place (Burgess & Green, 2009). Important content factors to consider are: style, topic, duration, delivery and presenter for example (Borghol, Ardon, & Carlsson, 2012; Figueiredo, Almeida, & Benevenuto, 2014).

Figueiredo et al. (2014) worked to understand the extent to which content matters for popularity of videos on YouTube. They used music and major league baseball videos in their study aimed towards a North American audience. They asked survey participants to anticipate which of two videos, with similar content-agnostic factors, they believed would become more popular on YouTube. The study then compared participants' predictions with video views as a measure of popularity. Whilst the preference of video enjoyment was found to be largely subjective, users were able to predict which video they believed would go on to be more popular. This sheds light on the importance of content playing a role in a video's popularity despite content-agnostic factors. Content factors are important in understanding the drivers of popularity on YouTube (Figueiredo, Almeida, & Benevenuto, 2014; Welbourne & Grant, 2016), but more research in this area would help to determine which content factors are most influential, especially if PGC wants to compete for views with UGC.

Effective communication on YouTube

'Audiences are not passive recipients, but active participants in science communication' (Rosenthal, 2018). Given YouTube's widespread popularity, audience reach, and social network features it presents a perfect springboard for science communicators to take advantage of. There is a wide range of science communication channels on YouTube, from professional channels such as National Geographic, Discovery Channel and BBC Earth Unplugged to amateur such as Smarter EveryDay, ASAP Science, and SciShow. Welbourne and Grant (2016) found within their sample that PGC channels tend to have more videos per channel than UGC channels, although they did not report on the relative proportions of PGC to UGC channels in general.

Whist both content and content-agnostic factors have been proven to influence the popularity of a YouTube video, the most important recommendation from YouTube is for a channel to host content which is inherently entertaining (Burgess & Green, 2009). Past research suggests those who actively seek out scientific videos have a prior interest in science (Rosenthal, 2018), but videos with higher entertainment values double effective learning (Khan, 2017). If a user finds a video entertaining, they are encouraged to actively engage with the video and seek out other related videos (Falk, Storksdieck, & Dierking, 2007; AbiGhannam, et al., 2015; Falk, et al., 2016). However, the users' perception of the source credibility will also influence their attitude towards the message (Zernigah & Sohail, 2012), and may determine how much they choose to engage in subsequent material.

Therefore, it is important for videos within the science and technology genre to be equally entertaining as they are authentic.

Differences between UGC and PGC videos on YouTube come down to production value (as described by Lo et al. (2010)) resources, and volume of videos (Welbourne & Grant, 2016).

> "**Amateur videos** were those in which the individuals in the videos were poorly lit, filming was done at home with a home video camera and there was camera shake" whilst "**Professional videos** appeared to be filmed with high resolution video cameras mounted on stable tripods, professionally staged in

> terms of lighting and make-up, and more elaborate sets for filming". (Lo, Esser, & Gordon, 2010).

> "Professionally generated channels often have superior financial resources compared with user-generated channels. Financial resources can allow professionally generated channels to increase the appeal of the channel and/or of specific videos through the creation of regular or large volumes of content and content of high production value." (Welbourne & Grant, 2016).

Evidence has suggested that amongst marketing videos on YouTube, UGC is often more trusted, viewed, engaged with being ultimately more popular. Factors that contribute towards the users' validation include: communicator expertise, experience, impartiality, affinity or being a source trusted within the consumers' social network (Borgatti & Cross, 2003; Heath, Motta, & Petre, 2007). The production value of a video sets the bar for what the viewer may expect from the video, this first impression is where the viewer first makes judgements about if they will enjoy the video and its authenticity.

This study aims to experimentally assess whether the same is true amongst science communication videos on YouTube as it is for marketing. One content factor that has yet to be looked at explicitly within science communication videos on YouTube is the production value of PGC and UGC comparatively. Would adopting or mimicking the production style of UGC lead to better engagement and participation in PGC videos, such as increased content viewing, likes, comments, shares and subscriptions? This forms the core question of the current thesis.

III. Methods

Introduction

This study assesses the role of production value of short science communication videos on YouTube. Figueiredo et. al (2014) showed that the role of content within a video is important when determining its popularity, despite agnostic factors. Their study showed that survey participants were able to predict which of two videos may go on to be more popular on YouTube, regardless of personal preference. Furthermore, Welbourne and Grant (2016) propose that UGC is capable of garnering just as much audience attention as PGC. Being able to further understand the nuances of what drives YouTube video popularity in the area of science communication is significant. It has potential to increase the effectiveness in which content creators can communicate effectively with their desired audience.

Experiment design and procedure

The study design used in Figueiredo et al. (2014) was a basis for this experiment, in which survey participants are asked to view two contrasting videos, and then surveyed about which video they predict will be most popular. In this experiment, the contrasting videos used are designed to mimic either a PGC or UGC style.

Lo et al. (2010) was used to guide the characteristics of each film, where PGC content was filmed using a tripod, had high picture and sound quality and was well lit. The UGC was filmed handheld using a smartphone and no specialised lighting or sound equipment was used. Additionally, production styles from existing YouTube channels were visually surveyed, and mimicked in the videos created for this experiment.

Two fake YouTube channels were designed to authentically host the videos made for this experiment. A visual survey of YouTube science-channel logos was done to support the conception of these designs. Earth and Global were chosen as the names and the following logos were designed accordingly (Figure 1).

Figure 1: Figure showing the two logos created for branding PGC and UGC videos.

The bright colour palette, and handwritten-style font used in the Earth logo was used deliberately to promote the idea that this video has come from an amateur creator. Contrastingly, the sleek navy Global logo was used to imply the video was from a professional source.

Pairs of films were created in PGC and UGC styles respectively were made for two different science topics, giving four films in total, creating two treatments (Figure 2).

Topics for the films were chosen in keeping with the existing natural history or science documentary genre, so as to be consistent and meet the research question. Film topics were chosen that came under the genre of science in order to be consistent and meet the research question. Topics were chosen that favoured neither a PGC nor UGC style so that it was easy to make both versions of the films comparable. For example, it would be very difficult to make a UGC video about something microscopic as it would require specialist equipment. Conversely, it would be unlikely that a PGC video may be set in a makeshift home laboratory. Therefore, original films were created for this study to ensure that the audience had never seen the films before. The video topics chosen were: Stoat Alpine Research and Water Quality Citizen Science.

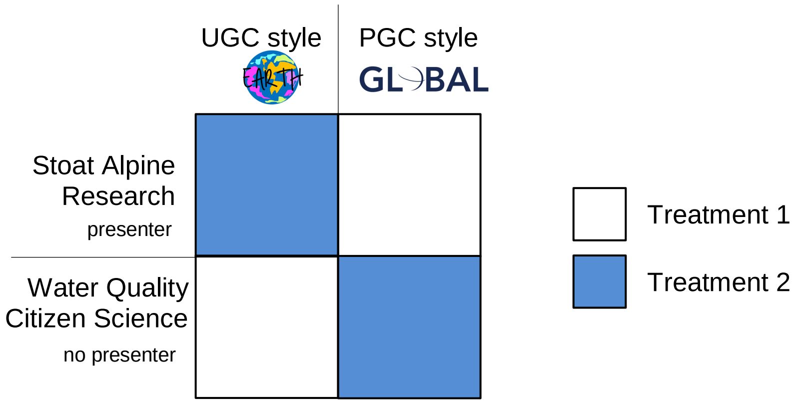

Figure 2: Figure showing Treatment 1 and Treatment 2 layout used in online survey.

Two near identical films were created for each topic, with the only variable changed being the production value. Each film was between 60-90 seconds long. The pairs of films used the same script to ensure the information delivered to the audience was identical and were filmed on the same set to reduce any other confounding factors. They used similar shots, and the placements of cuts were matched between the pair of films. Welbourne and Grant's study showed that the presence of a regular presenter was more characteristic of UGC channels, and that presenter-led videos had statistically more views than presenter-less videos (2016). Therefore, to control for the effect of having a presenter, one pair of films (stoat alpine research) was created using the same presenter whilst the other pair of films about water quality were presenter-less. They also used the same backing music. The two PGC films were branded with the Global logo whilst the UGC films featured the Earth logo.

The largest difference between the stoats and water films were camera movement and sound quality. For example, the PGC stoat film showed the presenter being interviewed from a stationary camera on a tripod, using high-quality radio-mics to record the sound. Whereas the paired UGC stoat film was filmed on an iPhone by the presenter himself, so had a much lower sound quality and jolty camera movements. The iPhone 8 used for the UGC has a 12MP camera, whilst the PGC was filmed on a broadcast-level Panasonic P2HD. By the time the films were exported and uploaded to YouTube, surprisingly the image quality between the two films were less obvious, but still distinct.

Films created for this study can be viewed at the following addresses or are enclosed as a CD for the examiner to view.

Global Water Quality https://www.youtube.com/watch?v=5_dmOM9Il40
Earth Water Quality https://www.youtube.com/watch?v=6wnCEeIApHw
Global Stoat Research https://www.youtube.com/watch?v=rMt0FELpvMc
Earth Stoat Research https://www.youtube.com/watch?v=a6IKHqEN2Mc

A Qualtrics survey was created and distributed via Amazon Mechanic Turk to a North American audience and aimed to capture a sample size of 500 candidates per treatment (1000 in total). YouTube has a large viewer base from North America (Ipeirotis, 2010; Paolacci, Chandler, & Ipeirotis, 2010; Ross, Zaldivar, Irani, & Tomlinson, 2010). Candidates who completed the survey successfully were awarded USD$0.50.

Candidates were asked demographic questions (Figure 4, Section A) and then randomly assigned to either treatment one or treatment two (Figure 2), where they watched the respective videos. The order of films was randomised each time. Candidates were then asked a series of questions to evaluate the videos (Figure 4, Section B) in a randomised order. These questions were taken from the Figueiredo et al. (2014) study, but slightly modified as required to suit the nature documentary content of this study. In these questions the branding (Earth or Global) of the videos was reiterated the reinforce the associations between style and brand.

In questions B1, B2 and B3, evaluating enjoyability, shareability, predicted popularity, candidates were able to choose their answer between the two videos they had watched (Figure 4). Response options for question B4 (How reliable did you find the information in the video to be?) were scaled on a Likert scale ranging from 'very unreliable' to 'very reliable'.

Question B5 (If you were to watch another video, which one would you choose?) was added to the survey as a behavioural test of the candidate's responses. Throughout the survey, I aimed to get the respondent to associate 'Earth' with a UGC video, and 'Global' with a PGC video by always referring to them as so. Video thumbnails for each brand were made for the respondent to choose between (Figure 3). The images for these thumbnails were both taken from the same video but overlaid with the relevant branding.

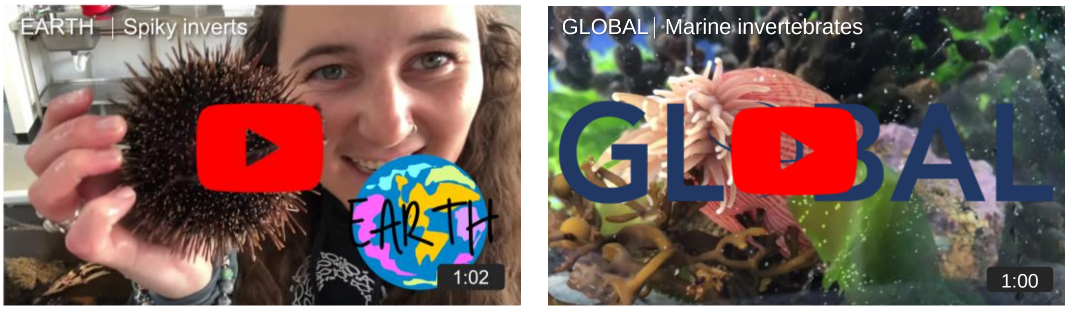

Figure 3: Branded video thumbnails designed for survey questions B5, If you were to watch another video, which one would you choose?

At the end of the survey the respondents were automatically redirected to a complimentary UGC 'Earth' marine invertebrate video on YouTube that they could watch at their own leisure.

Section A Demographic survey

1. How old are you?
2. Which gender do you identify with?
3. How often do you watch a video on YouTube?
    - *Never, rarely (few times a year), occasionally (few times a month), often (few times a week), very often (once or more daily).*
4. How often do you watch natural history/science videos online? (e.g. YouTube, Vimeo, Facebook)
5. How often do you share YouTube videos with people you know?
6. How often do you share any kind of online content with people you know?

Section B Video evaluation

1. Which video did you enjoy watching more?
2. Which video would you be most willing to share with people you know?
3. Which video do you predict will be more popular on YouTube?
4. How reliable did you find the information in the video to be?
    a. Stoat alpine research
    b. Water quality citizen science
5. If you were to watch another video, which one would you choose?

Figure 4: Survey questions used on Amazon Mechanical Turk, modified from Figueiredo et al. (2014).

Data quality management

Whilst Amazon Mechanical Turk is an excellent platform for distributing to many participants and has a quick turn-around time, there are some known issues with data quality. As each successful survey response is monetised, there is incentive for Internet hackers to multiply their responses. Chandler and Pailacci (2017) discuss problems with respondents falsely self-reporting their qualification for participation in paid Amazon Mechanical Turk studies, furthermore discussing the difficulty researchers face when discerning whether responses are valid or not.

Pre-screening questions and using a duplicate response blocker are recommended to minimise the number of fraudulent responses to a survey. Whilst both barriers can be overcome by determined respondents, Qualtrics' 'Prevent Ballot Box Stuffing' option as used in this study was found to reduce the number of duplicate answers by 80% (Chandler & Paolacci, 2017).

A consent form was used for this study, in order to meet the University of Otago's Ethics approval. Candidates were also required to disclose that they were over the age of 18 and were a North American resident. If they did not approve these terms they were redirected out of the study and received no payment.

The Amazon Mechanical Turk survey was set to be live until 1000 responses were collected. The final number of complete responses collected was 1252 as respondents who were completing the survey whilst the 1000th survey was completed were not re-directed out of the survey. These successful respondents were included and compensated accordingly.

The raw data was cleaned by looking at the metadata provided by Amazon Mechanical Turk. Incomplete survey responses were removed, and repeat IP addresses, coordinates outside of North America and unreasonably fast response times were evaluated in order to prevent false data being included in statistical analysis. This reduced the final number of valid responses down to 900*.

*I checked and yes, the final number by chance was indeed exactly 900.

Statistical analysis

Data was analysed in IBM SPSS version 1.0.0.1131. Histograms were plotted to visualise the responses to the demographic questions of the survey in Section A. For questions B1, B2 and B3, (enjoyability, shareability, predicted popularity) responses were coded according to their treatment to distinguish the topic, ‘water’ or ‘stoats’, and the production value, ‘high’ or ‘low’. A Pearson’s Chi^2 analysis was conducted on these categorical responses. For a 95% confidence interval with one degree of freedom, the critical chi^2 value is 3.84. A p-value of 0.05 was used to reject the null hypothesis.

Question B4’s (How reliable did you find the information in the video to be?) responses were scaled from 1-5, 1 denoting ‘unreliable’, and 5 denoting ‘very reliable’. By giving each response a numerical value, a ‘reliability proportion’ (RP) could be calculated. The RP was used to compare the relative reliability of the video production value (high and low) (RP_1) and also the video topic (stoats and water) (RP_2). RP_1, comparing the reliability of video production value, does not take into account the video’s topic. Similarly, RP_2, comparing the reliability of video topic, does not take into account the production value.

$$RP_1 = \frac{\text{‘high’ reliability}}{(\text{‘high’ reliability} + \text{‘low’ reliability})} \qquad RP_2 = \frac{\text{‘stoats’ reliability}}{(\text{‘stoats’ reliability} + \text{‘water’ reliability})}$$

Figure 5: Formulas used to calculate the reliability proportion (RP).

The RP scores can range from 0 - 1 (Figure 5). For example, if the survey respondent perceives both videos to be equally ranked on the Likert scale (unreliable – reliable, 1-5), the RP will be 0.5. However, if they view the stoats video as more reliable than the water video, the score will be closer to 1. If they view the water video to be more reliable than the stoats topic, the score will be closer to 0. Furthermore, if they perceive the high-quality video to be more reliable, the RP score will be closer to 1, conversely a more reliable low-quality video will provide a score closer to 0 (Figure

6). Histograms of each reliability proportion were used to visualise the responses to this question.

Question B4 ‘If you were to watch another video, which one would you choose?’ was analysed with a histogram plot.

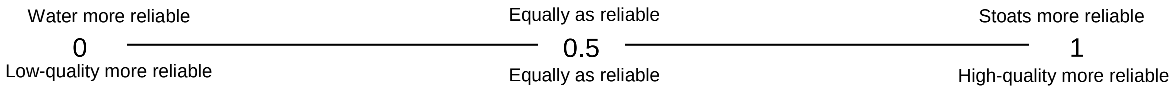

Figure 6: Visualisation of the reliability proportion scale calculated to analyse question B4, How reliable do you find the information in the video to be?

IV. Results

The results from the Amazon Mechanical Turk in response to the UGC and PGC videos designed for this survey will be presented in this chapter.

Section A: Demographic data

Histograms were plotted to visualise age and sex distribution of the survey respondents (Figure 7).

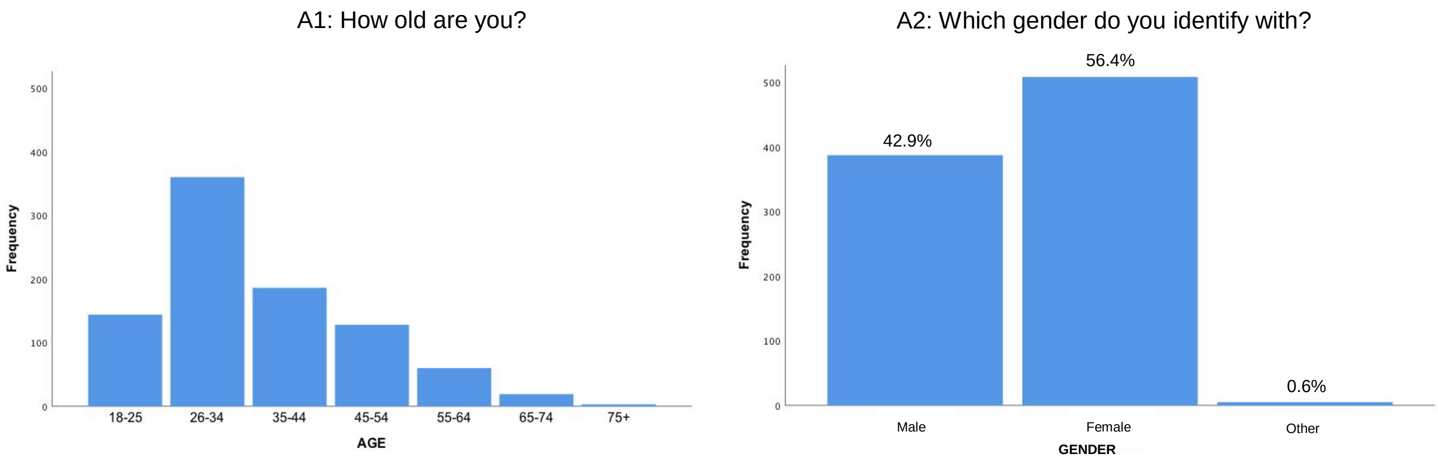

Figure 7: Figure showing age sex distribution of survey candidates in response to demographic survey questions A1, (How old are you?) and A2 (Which gender do you identify with?), n=900.

Results from demographic survey show that the largest cohort of survey respondents were between the 26-34 age-range. 76.7% of respondents were between the ages of 18 and 44 (Figure 7). There was a higher percentage of women who completed the survey than men (Figure 7).

Histograms were used visualise the survey respondents' answers to questions A3-A6, evaluating about how frequently the respondents interact with videos online (Figure 8).

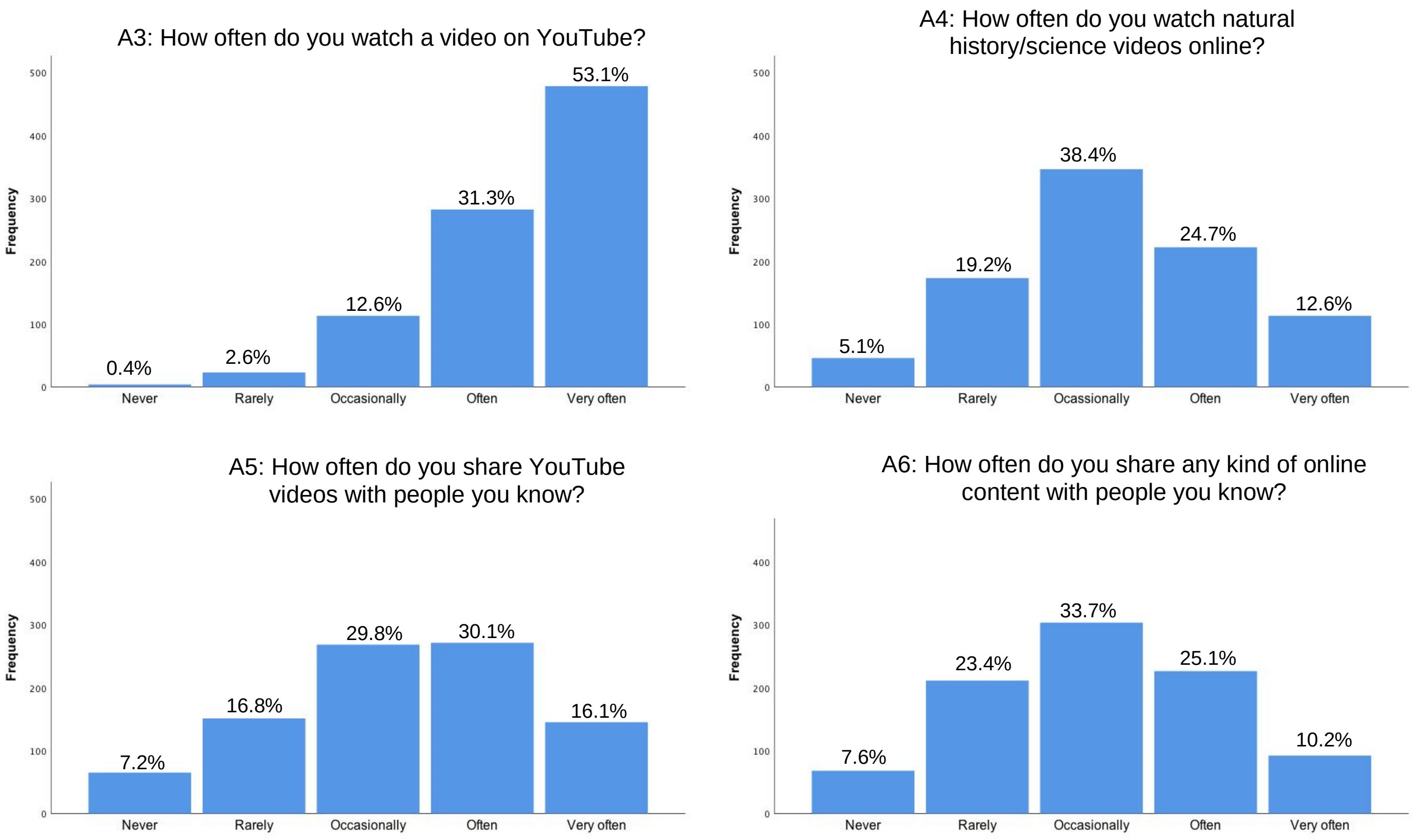

Figure 8: Figure showing candidate responses to demographic questions on a Likert scale, n=900.
A3: How often do you watch a video on YouTube?
A4: How often do you watch natural history/science videos online?
A5: How often do you share YouTube videos with people you know?
A6: How often do you share any kind of online content with people you know?

Results from the demographic survey in response to question A3 (How often do you watch a video on YouTube?) show a positive skew toward the frequency of how often candidates watch a YouTube video, with 52.8% watching YouTube videos once or more daily. Candidate responses to questions A4 (How often do you watch natural history/science videos online?), A5 (How often do you share YouTube videos with people you know?), and A6 (How often do you share any kind of online content with people you know?) follow a bell-shaped distribution pattern (Figure 8).

At this point in the survey, the candidates were randomly split evenly into two treatment groups. The proportions of candidates in each treatment can after data cleaning are displayed in the following bar graph (Figure 9).

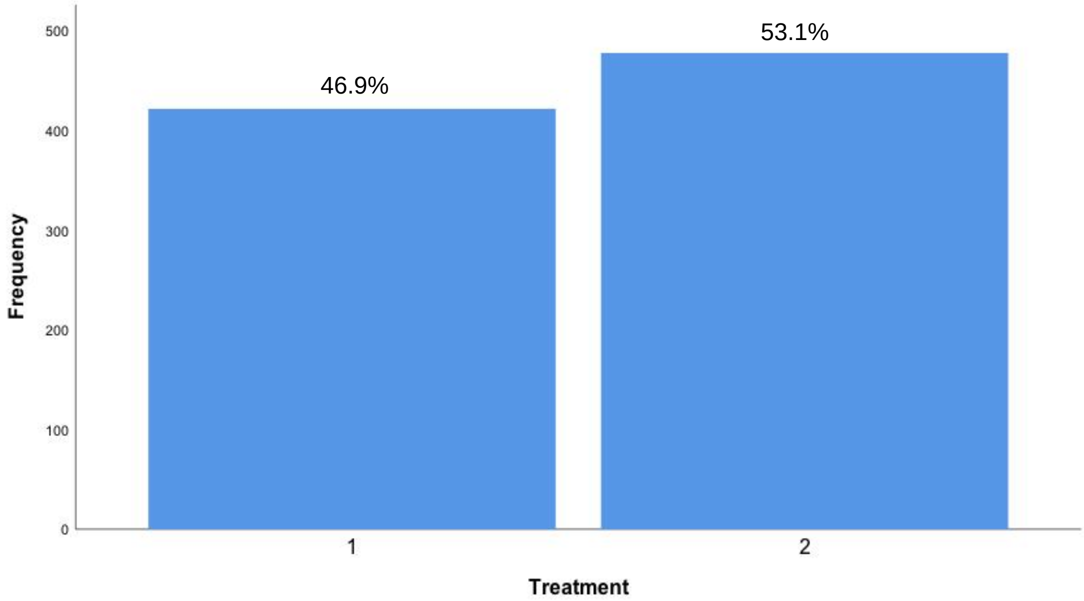

Figure 9: Figure showing the split of candidates into treatment one or two for survey part B 'Video evaluation', n=900.

The number of candidates within each treatment group was slightly imbalanced, with 53.1% survey responses coming from treatment two and 46.9% from treatment one. The difference in number of individuals between treatment one and two was 56 people (Figure 9).

Section B: Video evaluation

In part B of the survey, respondents evaluated the videos they watched in their respective treatments. These results are displayed below.

B1 Which video did you enjoy watching more?

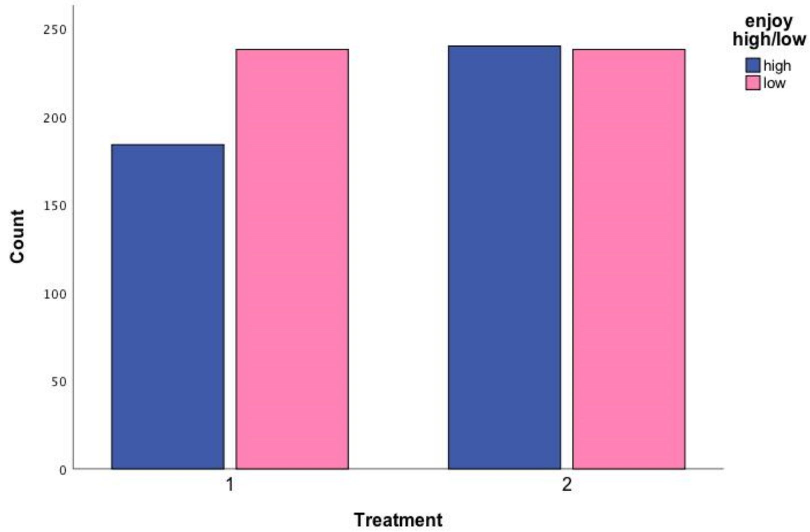

Figure 10: Bar chart showing Pearson's Chi squared analysis of question B1 comparing enjoyment of high and low production value of videos across both treatments $\chi^2(1) = (3.927)$, $p = 0.048$, $n=900$.

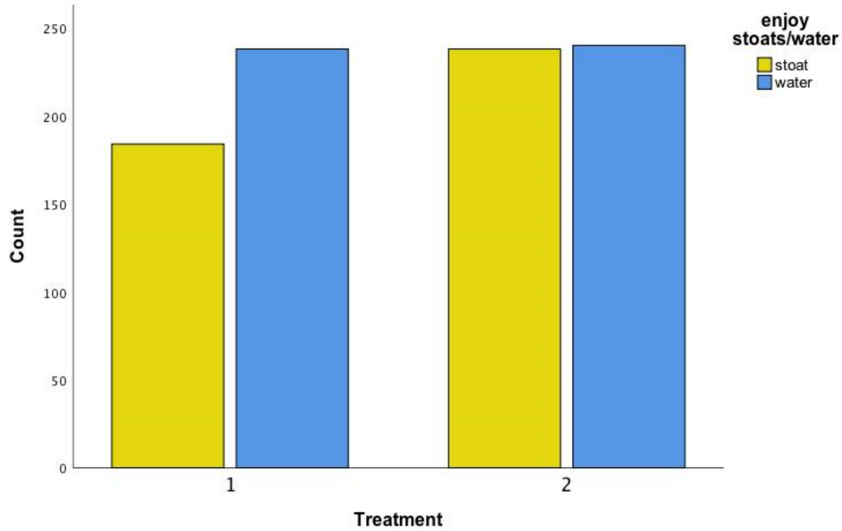

Figure 11: Bar chart showing Pearson's Chi squared analysis of question B1 comparing enjoyment of video topics across both treatments $\chi^2(1) = (3.447)$, $p = 0.063$, $n=900$.

Results from a chi-squared analysis to compare the enjoyment of surveyed videos (Figure 10) show that participants did significantly enjoy the lower quality UGC video over the higher quality PGC video with a 95% certainty. Participants also significantly enjoyed the water quality topic more than the stoat research topic (Figure 11).

B2 Which video would you be most willing to share with people you know?

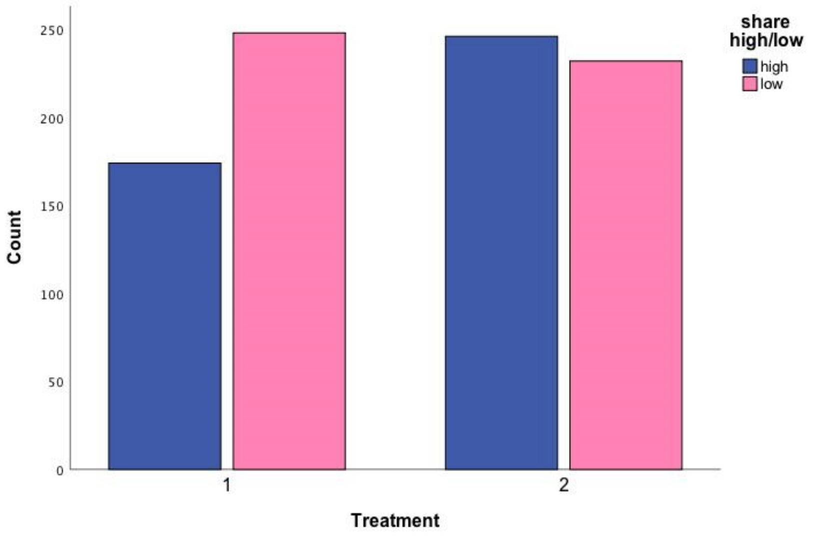

Figure 12: Bar chart showing Pearson's Chi squared analysis of question B2 comparing shareability of high and low production value of videos across both treatments $\chi^2(1) = (9.428)$, p = 0.002, n=900.

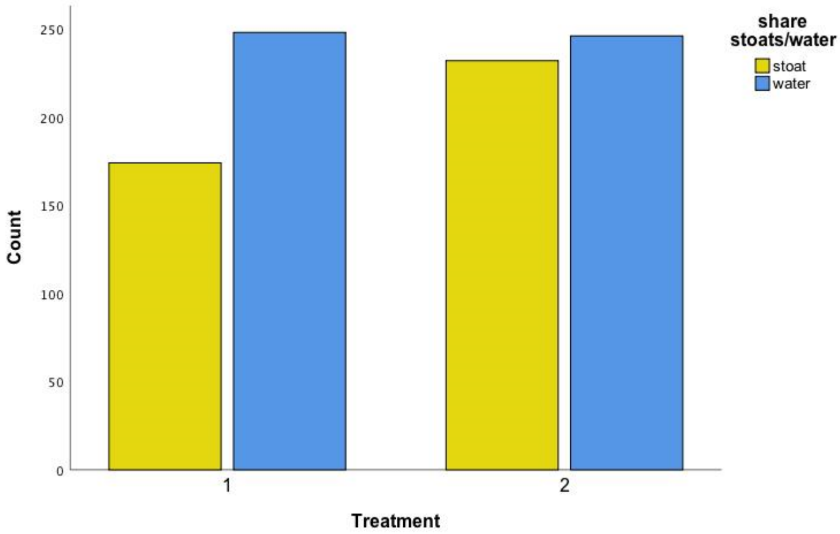

Figure 13: Bar chart showing Pearson's Chi squared analysis of question B2 comparing shareability of video topics across both treatments $\chi^2(1) = (4.828)$, p = 0.028, n=900.

Chi-squared analysis on question B2 (Which video survey participants were more willing to share?) show that UGC value videos are significantly more likely favoured than PGC videos (Figure 12). Figure 13 significantly shows that participants were more willing to share the videos about water quality than they were about stoat research.

B3 Which video do you predict will be more popular on YouTube?

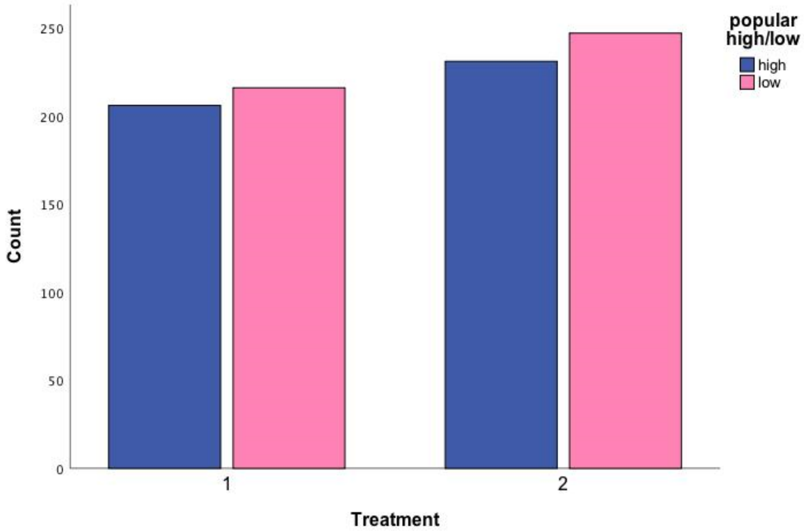

Figure 14: Bar chart showing Pearson's Chi squared analysis of question B3 comparing predicted popularity of high and low production value of videos across both treatments $\chi^2(1) = (0.21)$, $p = 0.884$, n=900.

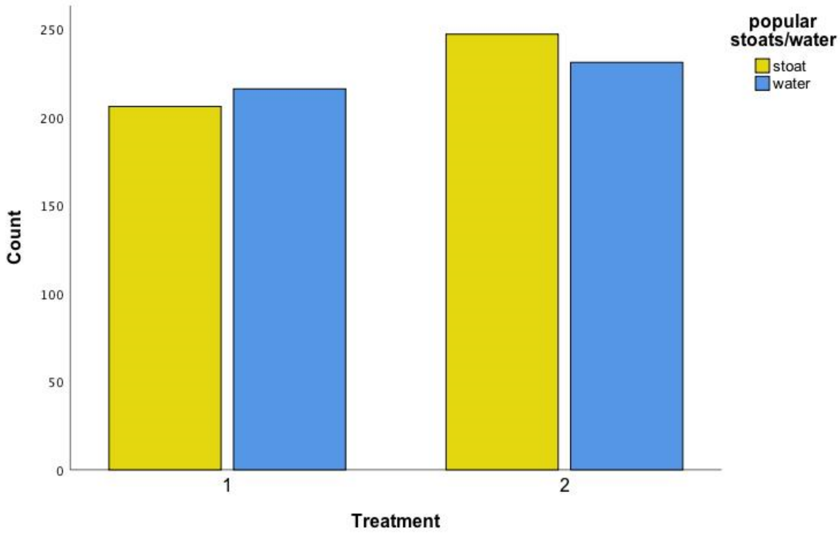

Figure 15: Bar chart showing Pearson's Chi squared analysis of question B3 comparing predicted popularity of video topics across both treatments $\chi^2(1) = (0.733)$, $p = 0.392$, n=900.

Chi-squared analysis on the predicted popularity of high and low production value video shows no significant preference (Figure 14). When comparing the same question for video topic, there is also no significant difference (Figure 15).

	Chi²		*p-value*	
	High/Low	Stoats/Water	High/Low	Stoats/Water
B1 Enjoyability	**3.927**	3.447	**0.048**	0.063
B2 Shareability	**9.428**	**4.828**	**0.002**	**0.028**
B3 Predicted popularity	0.21	0.733	0.884	0.392
				***significant**

Table 1: Table summarising the Pearson's chi² test and p-value of survey questions B1, B2, and B3 showing the significant results with a chi² significance value of 3.84 and a p-value significance value of 0.05.

Table 1 summarises the results presented in Figures 10 – 15. It shows that overall, B2 'Which video would you be most willing to share with friends' had the most significant difference, and that the strongest result was found when comparing the video quality (high/low). There was a small significant result when comparing the enjoyability of videos with different production values (Table 1, B1). The effect of video topic on this question (B1), was not significant, but close to the cut-off values used. There was no significant difference in the predicted popularity between video production value or topic.

B4 How reliable did you find the information in the video to be?

Reliability proportions (Figure 5**)**, were calculated to evaluate the relative reliability of video production quality (RP_1) and video topic (RP_2) are displayed in the figures below (Figure 16, 17).

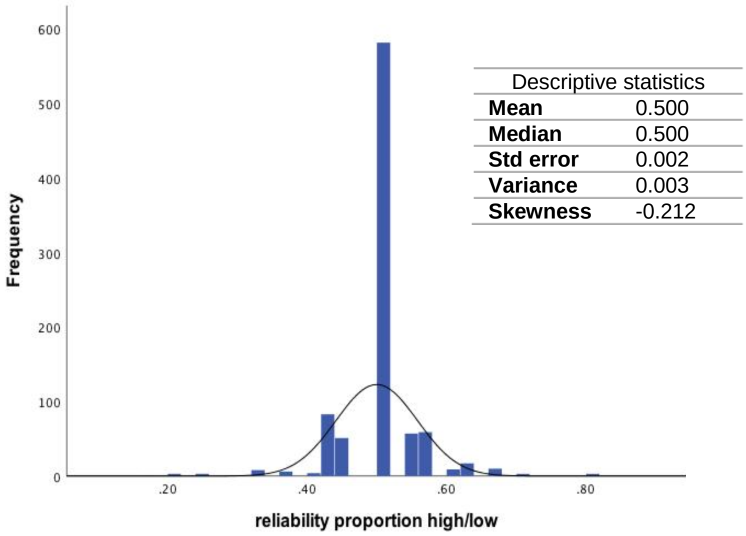

Figure 16: Histogram of reliability proportion (RP_1) scores for high and low production value videos, n=900.

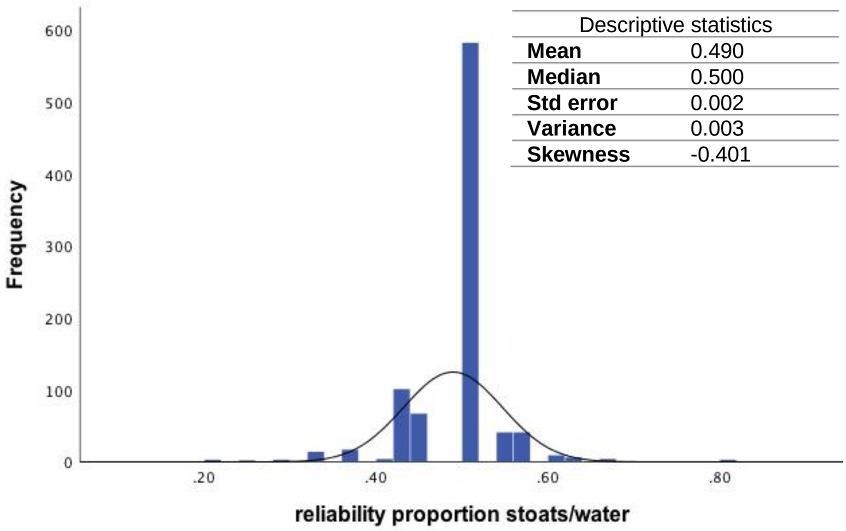

Figure 17: Histogram of reliability proportion (RP_2) scores for water and stoat video topics, n=900.

Figure 16 shows that the mean RP_1 score, comparing the video quality (high vs low), is 0.5 and the median is also 0.5. Figure 17 shows that the mean RP_2 score, comparing video topic (stoats vs water) is slightly lower, at 0.49 and the median is 0.5. Both figures have a small standard error of 0.02 and small variance of 0.003. Both figures are negatively skewed, meaning the RP is slightly asymmetrically distributed around the mean, the peak of the curve falls above 0.5 and the ‘tail’ is longer below 0.5.

B5 If you were to watch another video, which one would you choose?

A histogram of candidate responses was used to reflect responses to the behavioural question, B5.

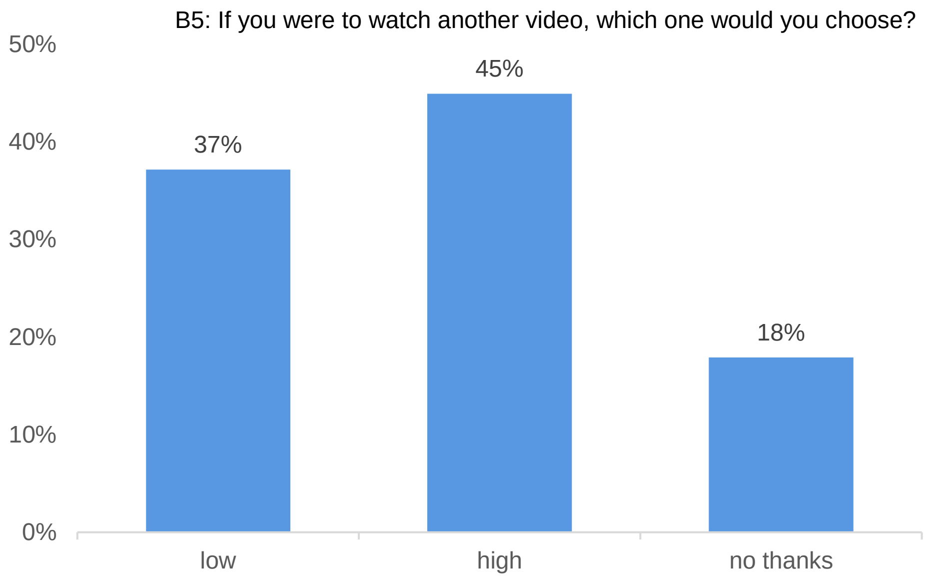

Figure 18: Histogram of candidate responses to question B5, ‘If you were to watch another video, which one would you choose?’, n=900.

Figure 18 shows that of the 82% of candidates who answered question B5, 55% of them chose to watch a video from the PGC Global channel, whereas 45% of them would like to watch another UGC Earth video. 18% of candidates chose not to answer this question.

V. Concluding discussion

This thesis aimed to experimentally test whether the production value of short science videos hosted on YouTube influenced how much the desired audience engaged with and enjoyed the videos. This was done by constructing pairs of short videos, consistent with the science genre, that were made to mimic PGC and UGC respectively. These near identical videos were designed to eliminate confounding content variables, by being created specifically for this study. Following Figueiredo et al.'s study design (2014), a survey was conducted on Amazon Mechanical Turk, where participants were asked to watch one PGC film and one UGC film. They were then asked key questions about which video they enjoyed more, which one they were more likely to share with people they knew, which video they predicted would be more popular, and how reliable they found the information in the video to be. Demographic information about survey candidates was also collected. This chapter will discuss the results of this survey in relation to the literature.

Section A: Demographic data

The demographic spread of survey respondents (Figure 7), show a higher proportion of younger individuals, with 76.7% between the ages of 18 and 44. Furthermore there was a higher proportion of females to males who completed the survey. Previous research has found that survey respondents on Mechanical Turk are not wholly representative of the Internet-using population, or the North American population (Ipeirotis, 2010; Paolacci, Chandler, & Ipeirotis, 2010; Ross, Zaldivar, Irani, & Tomlinson, 2010), often being younger with a higher proportion of females. However, the demographic spread in this study is consistent with demographics other published work that has recruited respondents using Mechanical Turk (Paolacci, Chandler, & Ipeirotis, 2010; Ross, Zaldivar, Irani, & Tomlinson, 2010) and is representative of Mechanic Turk users.

This section of the survey also asked applicants about their normal Internet use surrounding their interaction with online videos and online science content. Questions A3, A4, A5 and A6 (How often do you watch a video on YouTube?, How often do you watch natural history/science videos online?, How often do you share YouTube videos with people you know?, How often do you share any kind of online content with people you know?). The survey results (Figure 8, A3, A4), reflecting participants' online video watching habits show that a large proportion of the participants interact with online videos regularly, whilst their interaction with science videos specifically was less-frequent relatively. Although Figueiredo et al.'s study only had a sample size of 72 for each round of their experiment (2014), whereas this study surveyed 900 individuals, the trend of responses to the question 'How often do you watch a video on YouTube?' match. The pattern of survey responses to 'How often do you watch natural history/science videos online?' (Figure 8, A4), is less positively skewed. If viewers had no control over the types of video they were interacting with, it would be plausible that their interaction with science videos would follow a proportional pattern to their general video-watching habits. However, these results show that most people watch science videos on a monthly basis, whereas they interact with general video content more frequently. This may indicate that in general, viewers are less engaged with online science content. An important thing to acknowledge here however, is that online content is not engaged with at random. Many online platforms use targeted algorithms to promote or recommend content based on the user's search history; content is also self-propagated by other users' engagement which creates positive feedback loops (Szabo & Huberman, 2010;

Borghol, Ardon, & Carlsson, 2012; Figueiredo, Almeida, & Benevenuto, 2014). Therefore, users already engaged in science content are more likely to interact with it more frequently, whereas users who are unengaged in science content are less likely to encounter it. Furthermore, it is worth considering what participants consider as natural history and science content. The genre was not specifically defined in the survey, and there are many videos online which could be ambiguous.

In this section of the survey, respondents were also asked about their sharing habits of YouTube, and online content (Figure 8, A5, A6). The histograms of these two responses are similar to one another, they also show a similar trend to Figueiredo et al.'s study (2014). This indicates that the online content that respondents share is quite likely composed of YouTube videos. Known statistics about YouTube indicate that 60% of all online videos are watched through the YouTube website (Gill, Arlitt, Li, & Mahanti, 2007; Cheng, Liu, & Dale, 2013) and that YouTube is the second most visited website worldwide (Alexa Web Information Service, 2019).

Section B: Video evaluation

The results summarised in Table 1 reflect the statistical values recorded in response to preference of video for questions B1, B2 and B3 about the videos' enjoyability, shareability, predicted popularity. There was no significance between tested categories: production-value (high/low) and topic (stoats/water), for the predicted popularity of the video. There was a small significant indication that UGC videos were regarded as more enjoyable and a strong significant indication that lower quality videos would be more likely shared. Question B4 about the videos' reliability showed no significant preference to video topic or production value. Results for question B5 regarding future viewing preference showed that more recipients opted to watch another PGC video than a UGC video. Each result will be discussed in more detail below.

Predicted popularity

In this study, there was no statistical difference in the predicted popularity between video topic or production value. The chi^2 score 0.21 (Table 1, B3**)** between PGC and UGC videos was the lowest score of all combinations analysed, showing no preference between the choices overall. It is interesting that in both Figueiredo et al.'s study (2014) and this one, the enjoyability and shareability results were very different to the predicted popularity results. Whilst the participants showed they enjoyed UGC more and were more willing to share the UGC, their personal preference did not translate to which video they perceive will be more popular.

Asking about predicted popularity requires the candidates to consider a collective group's outcome (Figueiredo, Almeida, & Benevenuto, 2014); a popular video is deemed so because of its combined views, likes comments and shares. The results from this study show they may not necessarily be taking their own personal preference into account. This is in line with Figueiredo et al.'s findings (2014). Survey candidates may not be confident that their own preferences are shared by others, it seems that the overall perspective is that PGC will be equally as popular as UGC despite personal preferences. PGC is more likely targeted towards a general audience, whereas UGC may be more-niche; and therefore gives the impression that it is less-liked collectively.

Unlike the Figueiredo et al. study (2014), this study did not follow up with which videos were most popular over time. This was because these videos were not publicly available and created solely for the purpose of this study. Additionally, it is hard for a new YouTube channel to gain traction (Borghol, Ardon, & Carlsson, 2012) and engagement. However, it would be interesting in the future to take this study further by posting the videos online to channels that already have a high level of engagement as a springboard and follow content-agnostic popularity measures such as views, likes, comments and shares through time.

Enjoyability

The results from this experiment indicate that there is a significant difference between enjoyability of UGC and PGC videos online, and that UGC are more enjoyable. There was no statistically significant indication that the topic of the video influenced the enjoyability. The UGC stoat video was delivered in a very personable way, by the presenter inviting the viewer to accompany them with their research and using eye-contact with the camera. The presenter filmed himself using an iPhone, which may have made the viewer feel more involved than the PGC version which was less intimate with an interview set-up. In the presenter-less water quality videos, the tone of voice used in the UGC video was far more causal than the PGC despite having lower sound quality overall. These results indicate that the more informal style, characteristic of UGC, is enjoyed more in the context of YouTube.

Scott et al. (2016) evaluated the perceived quality and enjoyment of short movie clips across different personalities and cultures. As they were using existing movie clips, they did not use a UGC style as their low-quality, instead low-quality was defined by lower frames per second (fps), frame dimension and bit-rate. They found that the perceived quality of a low-quality video can be overlooked, or even perceived to be higher depending on the context. Whilst, they do note that this result might be stronger when looking at movies with strong narratives in comparison to YouTube videos, it is interesting to consider that viewers may be less-concerned with the quality of video itself if other factors increase overall enjoyment. It would be interesting to evaluate factors that contribute to a viewer's overall enjoyment, for example narrative drive, comedy, entertainment, intrigue or character likeability. Contrastingly, this research indicates that the content might play more of a role in overall enjoyability rather than video quality.

Still, within the science communication genre, Welbourne and Grant show that amongst channels defined by their production value, UGC are far more popular. Their measure of popularity was based on views, comments, of subscriptions driven from the video, number of shares and number of ratings (2016). The more a user engages in content, the more they enjoy it (Burgess & Green, 2009). Therefore, it is reasonable to use engagement as a proxy for enjoyability. Other than the production value, I wonder whether there are other overarching factors that this UGC shares which may explain why these videos are more enjoyed?

As suggested previously, it would be interesting to post the videos created in this study publicly to track video statistics temporally.

Shareability

The strongest significant result from this experiment was that the UGC were more likely to be shared than their PGC counterparts. It is interesting that this result is much stronger than the comparable enjoyability of the videos. Welbourne and Grant's study (2016) found that PGC videos were shared more than UGC, however UGC had statistically more views per share event than PGC. There may be a difference between what users say they will do, and what they actually do. Khan studied which factors influence user participation on YouTube (2017) and found that the strongest motivators for sharing a video were giving information, self-status seeking and relaxing entertainment. If participants are wanting to actively engage with their social media connections, they may do so by sharing content. Sharing is a core part of any social network, allowing users to create interconnected communities and groups, particularly on YouTube users become part a 'video village' (Cheng, Dale, & Liu, 2007). Sharing videos indicates a higher level of social media engagement than just liking or commenting (Mutinga, Moorman, & Smit, 2011).

General Internet users may not visit the YouTube site directly to seek video content, instead view it on other sites due to shares, this has a domino effect facilitating more shares elsewhere. However, because of the close community that exists between UGC users on YouTube's social network, it is likely that UGC vidoes are encountered more organically through the YouTube recommendation system and so have less frequent shares outside of the YouTube site.

The willingness to share is arguably a stronger indicator of overall enjoyment of a video as it shows active engagement. The fact that the experimentally, UGC was significantly more likely to be shared is a finding that is hugely relevant to the overarching question of this thesis: that production value does influence how much the audience is likely to engage with YouTube content.

Reliability

The results from this study showed that there was no difference in the perceived reliability of PGC or UGC videos and between topics. This is interesting as previous research in the marketing industry has shown that viewers perceive UGC to be more trustworthy than PGC (Cheong & Morrinson, 2008; MacKinnon, 2012).

Welbourne and Grant summarise that consumers identify trusted sources online through communicator expertise, experience, impartiality, affinity and a source being trusted within a content consumer's social network (2016). Both UGC and PGC stoat films featured a presenter whereas the water quality video had an off-screen presenter. These results do not show whether the presence of a presenter influenced the perceived reliability of the two study films.

Behavioural Response

A surprising finding of this study shows that survey respondents reported on enjoying the UGC videos more and would be more likely to share the UGC videos. Yet, overall their enjoyment did not translate to a behavioural response, with more candidates opting to watch another PGC video over another UGC video in the future. This is particularly surprising as it contradicts what might be expected based on the reported enjoyment and willingness to share. Furthermore, it highlights the need for further attention to this topic in general, as these results indicate a more complex level of understanding is required.

It is possible that this result could be down to viewer fatigue, it is easier on the eyes and ears to watch content that is not shaky and has a better sound quality. When the viewer is aware that they are going to invest some time in watching content then perhaps they prefer a higher-quality video, even though on the short-time scale a low-quality video is more entertaining.

However, Welbourne and Grant's study showed that UGC science communication channels on YouTube have more subscriptions than PGC channels (2016). This seems to support that viewers are engaging with more UGC on the long-term than they are with PGC, indicating that viewer fatigue may not come into play.

To gain a better of this finding in the future it may be necessary to do a more in-depth analysis of the data and to separate the categories by previous candidate response to enjoyability, shareability and predicted popularity.

Limitations

This survey was conducted on a North American audience, however both pairs of videos in the survey were produced in New Zealand. Both presenter-led stoat research videos featured a male Kiwi host with an evident accent, whilst both water-quality videos had narration by me, with a weak blend of a British and Kiwi accent. With the crossover of videos in the survey design, the accent should not have impacted the results produced surrounding video production value. However, they could have influenced the direct comparison between video topics, as it is likely that a stronger Kiwi accent would be less-easily understood by the survey respondents than a softer accent.

Furthermore, the issue of stoats in New Zealand is quite a specialised topic that arguably is less relevant for a North American audience on the assumption that they have no prior knowledge of New Zealand's unique native flora and fauna. Visuals of deceased stoats and stoat bones in a laboratory which feature in both stoat videos may have been too graphic for some viewers. Contrastingly, the water quality citizen science topic may be more globally relevant, and perhaps this is a contributing factor as to why the candidates enjoyed and would share the water topic more.

Final remarks

This study starts to respond to the concluding call to action by Welbourne and Grant "We cannot assume that broad YouTube trends identified elsewhere apply to the science communication genre" (2016), and is the first if its kind to experimentally compare how the production value of a YouTube video influences user enjoyment and engagement.

With scientific and technological advances being rapid and often complex in this era, it is important that scientists are equally as concerned with translating research and developments to the wider public in a digestible manner. It seems that YouTube's success is closely intertwined with its set-up of primarily being a user-generated social network. This gives individual videos the potential for huge exposure provisional on user interaction – a platform that all scientists should consider when communicating their work.

This research indicates that a high-quality high budget production is not necessarily needed provided the topic is delivered in an engaging way. Particularly within the context of YouTube, user-generated science communication content fares just as well as PGC. It is unclear from these findings whether these stylistic differences will translate well into other genres or whether UGC would be as successful on broadcast television, but this is an interesting area for future studies.

In mind of this research, I think it is most important for content creators to be aware of the intended audience and purpose of their videos and consider this when deciding which style to follow. For example, UGC characteristics such as a handheld camera are widely used in live-action presenter-led wildlife film successfully (as seen in Steve Irwin shows). Additionally, fluid and steady-cam technologies are becoming increasingly available for the non-professional videographer and should not be avoided purely on the assumption that it does not suit the UGC style. Furthermore, the emerging area of virtual reality will no-doubt be a challenge for amateur creators, but with 360° cameras, perhaps they will be able to contribute.

A quote from New Zealand filmmaker, Pietra Brettkelly (2018) highlights that the AV equipment available should not necessarily govern the style the film should take "The interesting thing about technology is that everyone thinks they can do it (filmmaking)…and as creatives, I think that drives us to be better".

With a continually changing and rapidly-expanding landscape of online video there is huge need to further analyse the factors that govern overall popularity, enjoyment and engagement within niche genres like science communication.

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