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Conspiracy Theories and Flat Earth Videos on YouTube

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The advent of digital user-created media platforms such as YouTube has made possible the spread of a wide range of information without the constraints of traditional mass media such as editorial gate-keeping. This democratized user-created media environment provides an outlet for subject matter that would otherwise not receive broad exposure–including material that seeks to discredit specific scientific findings and science as a whole. The present paper examines YouTube videos that advocate the idea of a flat Earth and tests for conspiratorial ideation using a version of the Conspiratorial Mentality Questionnaire (Bruder, Haffke, Neave, Nouripanah, & Imhoff, 2013). The research finds that flat-Earth videos significantly outnumbered debunking videos, were almost twice as long on average and were more likely to include conspiracy ideation, science denial and religious thought and to reference other social media. On the other hand, debunking videos were more likely to reference established science and enjoyed greater favorability ratings from viewers.

Keywords: Science, flat-Earth, YouTube, Internet disinformation

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As networked online technologies and social media evolve outside the constraints of traditional gatekeeping, wildly spurious claims today compete with established science in the marketplace of discourse. As social media become entrenched in modern society, their potential for disinformation begs greater focus and interrogation (Shin, Jian, Driscoll, & Bar, 2018; World Economic Forum, 2014) and draws increasing concern. Kelly (2018, p. A6), for example, associated social media with a rise in flat-Eartherism and an increasing number of people rejecting traditional sources of information as the Internet gives rise to "a variety of alternative worldviews."

While a single unified definition of flat-Eartherism is difficult to find, the literature and swirling social media currents reveal several common elements of this body of thought. Loxton (2018, p. 9) has described the modern flat-Earth phenomenon as

containing varying beliefs that "usually involve a large disc-shaped world with a relatively tiny Sun and Moon circling above it like lamps above a table," adding that:

> Flat-Earth maps rearrange the continents and seas to radiate outward from the North Pole, which is imagined to be at the center of the disc. Everything we think of as the Southern Hemisphere is spread out around the outer circumference. It is usually claimed that Antarctica does not exist at all. Instead, the entire disc is encircled by a vast wall of ice that we mistake for a frozen southern continent.

The present paper investigates flat-Earth content on the video sharing site YouTube, testing for conspiratorial ideation and examines the social and epistemological implications of such content particularly as it challenges both established science and systems of knowledge.

LITERATURE REVIEW

The video sharing platform, YouTube is the second most visited website in the world (Alexa.com, 2017). Unless videos are deemed offensive or violate copyrights, they are generally free from even the most rudimentary gatekeeping (Lewin, 1947; Shoemaker & Voss, 2009) associated with traditional mass media. Such free access democratizes the processes of communicating with mass audiences (Carpentier, Dahlgren, & Pasquali, 2013; Fuchs, 2011) by providing "opportunities for bypassing mainstream media organizations and professionals" (Carpentier, et al., 2013, p. 292). Diverse motivations fuel the vast numbers of videos posted online, including the appeal of "viralness," their potential for creating prominence for their creators, possible monetization of the popularity of the media and the potential for advancing political views (Broxton, Interian, Vaver, & Wattenhofer, 2013).

Science denial and emerging challenges to scientific discourse

Scholars have expressed concerns about the displacement of Western science in the modern politics of information (Brown, 2008; Mooney, 2005). Gauchat (2012), for example, demonstrated that political conservatives in the United States have become increasingly skeptical of science and scientific information since the 1970s. Several commentaries have described this skepticism as translating into active opposition to science (Charles, Polis, Sridhara, & Blum, 2008; Elsasser & Dunlap, 2013; Hofstadter, 1970; Mooney, 2005)

though some attention has also been paid to the fact that liberals and conservatives may both choose anti-science ideas (Washburn & Skitka, 2018). Diverse scholars (e.g. Everhart & Hameed, 2013; Jacques, 2006; Pobiner, 2016) have also highlighted the links between religious thought and denial of established science.

Smithson (1993, p. 134) posited that the explosion of information and the "shorter half-life" of knowledge has created conditions by which meanings become less accessible, more subject to confusion and less credible to audiences (Eysenbach, 2008; Metzger & Flanagin, 2013; Misra & Stokols, 2012). Johansen and Josyln (2008) strongly suggested that modern users of information technologies (even highly educated users) are susceptible to false and unreliable sources on the Internet while Cook, Ellerton and Kinkead (2018, p. 1) called misinformation "a societal issue of growing concern" citing the World Economic Forum's (2014) assertion that online misinformation is a top global threat.

Conspiracy theories

Garwood (2007, p. 35) noted that the history of flat-Earth claims has involved "a plethora of conspiracies, counter-cultural critiques and subversive discourses..." The notion that the Earth is flat requires believers to adopt the accompanying idea that powerful forces have conspired to create a false narrative of the global Earth. Such conspiracy theories focus on claims of covert "plots by multiple powerful agents" (Wood, 2017) acting towards nefarious goals (Wood, Douglas, & Sutton, 2012), often global in scope and involving webs of deception and subterfuge by supposed perpetrators. Conspiracy theories have enjoyed widespread popularity even before the advent of social media, including "theories" about the assassination of John F. Kennedy, the death of Elvis Presley, the death of Princess Diana of Wales, the veracity of the moon landing and the influence of groups such as the Freemasons but have enjoyed renewed enthusiasm on various social media platforms today (Narayan & Preljevic, 2017; Smallman, 2018).

Wood (2017, p. 510) suggested that conspiracy theorists "adopt a strategy of sowing doubt and raising suspicion," using disbelief rather than data for their arguments. Knight (2000) linked conspiracy theories to feelings of powerlessness against powerful forces such as governments or corporations. Conspiratorial beliefs provide comfort to the powerless, suggesting that they at least possess an alternative or true version of reality (Goertzel, 1994). Douglas, Sutton and Cichocka (2017, p. 540) concluded that "conspiracy theories

valorize the self and the in-group by allowing blame for negative outcomes to be attributed to others." According to Kelly (2018, p. A6) flat-Earthers believe that the "ruse" of a globe Earth "is perpetuated by a powerful cabal determined to make humans feel small and powerless."

Flat Earth (terra non sit rotunda)

Garwood (2007) detailed Sumerian, Babylonian and Egyptian ideas of a flat Earth between the sky above and an underworld beneath, noting that the influence of these ideas on the nearby ancient Hebrew civilization has been linked to several Biblical passages often taken to support flat-Earth cosmology. These passages include descriptions of the "firmament" above (Genesis 1:7-10), references to the "ends of the Earth" (Deuteronomy 28:64) and an underworld below (Job 26:5; Numbers 16:33).

Pythagoras first proposed the notion of the globe in about 500 B.C.; more than a hundred years later, Aristotle offered evidence from physical observations and a further 250 years or more later Eratosthenes calculated the size of the globe (American Physical Society, 2006; Kuhn, 1957). Later, other concepts such as the replacement of Ptolemic geocentrism with the Copernican heliocentric solar system (Copernicus, [1543] 1976) would expand human understanding of the globe and the cosmos.

Fifteenth century sources (Lilio, 1496) as well as nineteenth century works such as Rowbotham's (1849, 1865) *Zetetic Astronomy: Earth Not a Globe* and Carpenter's (1885) *One Hundred Proofs that the Earth is not a Globe* reflected the occasional resurgence of flat-Earth ideas, often as a product of Biblical literalism. Englishman John Hampden pursued public confrontations and debates with scientific personalities issuing publications to argue for a flat Earth (Hampden, 1871). In 1870 he challenged scientists to demonstrate that the Earth was round with a wager of £500 (Garwood, Alfred Russel Wallace and the flat Earth controversy, 2001).

In 1923 Reverend Wilbur Glenn Voliva set up a 500-watt radio station at Zion, Illinois broadcasting as WCBD (Doerksen, 2005). Voliva believed that "the Earth is flat," "surrounded by an impassable barrier of ice" and the sky was "a solid dome above"; he also believed the sun to be "32 miles in diameter" at 2,700 miles away from Earth (The Amaroc News, 1922) and that gravity did not exist (The Coconino Sun, 1921; The Evening World, 1921) which assertion he sought to prove at a public demonstration using "a book, a toy

balloon, a brick and a feather" (The Evening World, 1921, p. 2). Using the new medium of radio, "Voliva's argument for a flat Earth" was "broadcasted from Zion City all round the world" (Slosson, 1924, p. 145).

In 1956, Samuel Shenton of England formed the Flat Earth Society and, primarily through television, radio and newspaper coverage, became the driving force behind the flat-Earth movement. Shenton's extensive use of mass media was not without its problems. He and his followers accused British Broadcasting Corporation (BBC) television of ridiculing their organization after Shenton appeared on their air and explained that missing persons cases could most plausibly be explained by them having walked off the edge of the Earth (Post-Gazette and Sun-Telegraph, 1960). In 1972, Shenton passed leadership of the Flat Earth Society to an American, Charles Kenneth Johnson. A biblical literalist, Johnson regarded science as a hoax intended to supplant religion, claimed that sunrise and sunset were optical illusions and that the moon landing was faked, spreading his ideas through newsletters and interviews with *Newsweek* magazine and the *New York Times* for several decades (Martin, 2001).

A wave of flat-Eartherism emerged with the increasing popularity of social media and the accessibility of video treatises on the subject in the early decades of the 21st century. Figures from entertainment and sports (including rapper B.o.B. and NBA player Kylie Irving) began to espouse and repeat the flat-Earth ideas on mass and social media. The first Flat-Earth International Conference and the first Flat Earth Film Festival were organized for Colorado in 2018. Organizer of the first UK flat-Earth convention (in April 2018) Gary John cited "an explosion of interest in flat-Earth theories and increased mistrust of governments" and argued that, in the previous five years, Facebook groups and Youtube accounts promoting the flat-Earth theory" had "gained tens of thousands of followers"

Research Questions and Hypotheses

The present investigation evaluated the content of YouTube videos dedicated to promoting the idea of a flat Earth and debunking videos aimed at countering that idea, posing research question 1 (RQ1): What are the proportions of flat-Earth claims relative to debunking videos and commentaries on YouTube?

This research was also concerned with the characteristics of flat-Earth videos and posed research question 2 (RQ2) as: What are the characteristics of flat-Earth videos on YouTube?

A related question pertained to concepts that bolster flat-Earth discourse including notions of a "firmament dome" that constitutes the sky and a perimeter wall of ice (Antarctica) that keeps the oceans from spilling over the edge of the flat Earth. To support these ideas, proponents rely on related conspiratorial claims such as the notion that the United Nations prevents people from journeying to Antarctica to prevent discovery of the ice wall. The study thus posed research question 3 (RQ3) as: What related anti-science concepts and conspiracies do flat-Earth videos reference?

Emerging from these research questions and based on the existing literature, the present investigation proposed several hypotheses to be tested. Since modern flat-Eartherism frequently involves claims that science is a hoax, a conspiracy foisted on society or simply unreliable or untrue (Crisp, 2018; Lewandowsky, Gignac, & Oberauer, 2013; Martin, 2001), the present research proposed hypothesis 1 (H1) as follows: Flat-Earth videos on YouTube are more likely than debunking videos to make broader claims about the fallibility of science.

While flat-Earthers are noted for science denial, the task of debunking the ideas in flat-Earth videos often requires reference to scientific concepts and methods including math and physics. To test this notion, the present study proposed hypothesis 2 (H2) as follows: Debunking videos will make greater use of scientific proofs than flat-Earth videos.

The connection between the flat-Earth philosophy or the broader denial of established science has been strongly associated with religious teachings and conservative political views, particularly in the United States (Gauchat, 2012; Mooney, 2005). For this reason, the present study proposed hypotheses 3a and 3b as follows:

H3a: Flat-Earth videos are more likely to be associated with positive notions of religion than debunking videos.

H3b: Where evident, partisan political expressions in flat-Earth videos are more likely to be pro-conservative.

Previous research suggests a social dimension to conspiracy theories (Douglas, Sutton, & Cichocka, 2017) and minority oppositional thinking such as the flat-Earth

concept. The present investigation thus sought to measure how much flat-Earth videos referenced other social media sources and other conspiracy theories in their presentations. Thus hypothesis 4 was proposed as:

H4: Flat-Earth videos are more likely to cite other social media as support for their views than debunking videos.

METHODOLOGY

To investigate these questions and test these hypotheses, the present study content analyzed flat-Earth and debunking videos on YouTube. An Internet search of videos featuring the exact terms "flat Earth" or "Earth is flat" limited to the site youtube.com yielded approximately 1,220,000 hits at the time (a number which has continued to increase). From a randomized start, the researcher/s sampled each tenth video (sorted by relevance) until the sample size was 500 (or approximately 0.04%).

Content analysis

Content analysis is a well-established approach to investigation of media discourses that can embrace both qualitative and quantitative techniques (Carney, 1972; Krippendorff, 2004) and has been used to study coverage of a wide range of issues in a variety of communication channels. This approach generally involves coding or other purposive reduction of media content into data sets that can be used to evaluate characteristics of media and examine relationships among their various themes.

Coding dimensions. Coding captured several objective measures for each video including the number of views, duration, date of publication, numbers of likes and number of dislikes. The investigation also coded each video on several content characteristics such as being for or against the flat-Earth concept as well as for containing specific claims including that science is fraudulent, connections with other conspiracy theories and political comments. The coding process employed a binary measure for such individual content scoring 1 when an item or theme was present in the video and 0 when the item or theme was absent. In subsequent analysis, when selectively combined, these binary measures provided the basis for scales such as the fallibility of science scale and the adapted Conspiracy Mentality Questionnaire (CMQ) scale.

Inter Coder Reliability. Inter-coder reliability was established from a comparison of test coding results performed on a sub-sample of the cases by the author and a trained external coder over several rounds. This process involved adjusting or dropping some initial categories that proved vague or otherwise problematic to definitively code. Krippendorff's alpha calculated for the remaining items demonstrated reliability ranging from strong ($\alpha > .89$) to acceptable ($\alpha > .7$).

Measuring the conspiratorial

Efforts at measurement of conspiratorial thinking have resulted in various scales and devices. In attempting to measure what they termed "conspiratorial ideation", for example, Lewandowsky, Gignac and Oberauer (2013) asked respondents about their belief in several long-standing but specific conspiracies such as the JFK assassination and a faked moon landing. Bruder et. al (2013), proposed a more generalized measure in the Conspiracy Mentality Questionnaire (CMQ), avoiding specific reference to individual stories or topics, asking instead if respondents believed that 1) many very important things happen in the world, about which the public is never informed, 2) politicians usually do not tell us the true motives for their decisions, 3) government agencies closely monitor all citizens, 4) events which superficially seem to lack a connection are often the result of secret activities and 5) there are secret organizations that greatly influence political decisions. The present study used these five general measures the coding scheme along with several ideas from flat-Earth conspiracies in the determination of conspiracy thinking in the present sample. Generally, these included corollary ideas around flat-Earth that require the above general conspiracy conditions to be true, such as the existence of an Antarctic ice wall guarded by United Nations troops and kept secret by world governments.

FINDINGS

Proportions of flat-Earth claims

The first research question (RQ1) was concerned with the relative prevalence of flat-Earth videos on YouTube. Of the 500 videos sampled, the majority ($n = 301$, 60.2 %) were coded as pro flat-Earth. By comparison, 139 (27.8%) were coded as debunking or anti flat-Earth. The combined total of videos coded as parody ($n = 20$, 4%), news ($n = 19$, 3.8%),

videos of neutral or indeterminate stance (n = 16, 3.2%) and overview videos (n = 5, 1%) comprised the remaining 60 (12%). Chi-square analysis of this distribution indicated that the observed frequencies in the sample were significantly different from chance (X^2 [2, N = 500] = 181.13, p < .01, V = .85).

Characteristics of flat-Earth videos

Research question 2 was concerned with the contents and characteristics of flat-Earth videos on YouTube. The findings indicated a dominance of flat-Earth videos in terms of numbers of videos and average duration with a wide range of content ranging from the pseudo-scientific to the conspiratorial. Sampled videos ranged in length from less than a minute to 360 minutes with an average duration of 23.9 minutes with pro flat-Earth videos averaging 29.79 minutes (n = 301, SD = 41.34), debunking videos averaging 14.94 minutes (n = 139, SD = 22.16) and all others averaging 15.08 minutes (n = 60, SD = 24.47). Analysis of variance (ANOVA) indicated that the observed differences in the lengths of videos in each category were significant ($F_{2, 497}$ = 10.59, p < 0.001, η^2 = 0.041) with post-hoc analysis showing that the average duration of pro flat-Earth videos (29.79 minutes) differed significantly from both debunking (14.94 minutes) and "other" (15.08 minutes) categories at p < .01 while the debunking and other videos did not differ significantly from each other in length.

These videos garnered anywhere from 47 views to over 15.6 million views in one case. Averages for the numbers of views tended to be quite skewed due to the involvement of several Youtube producers with vast followings chiming in on the flat-Earth video phenomenon. The overall average number of views per video was 319, 760 (SD = 959,320). Pro flat-Earther videos averaged 128,584 views (SD = 228,052.75), debunking videos averaged 400,916 views (SD = 659,474) while videos presenting overviews, news or parody garnered, on average, 1,090,993 views (SD = 2,386,397).

There were 39 videos in the sample (7.8%) with more than one million views and of these most-viewed videos, debunking videos predominated, accounting for 16 (41%) of the 39 with pro flat-Earth videos accounting for only 6 of the 39 (15.4%). Even parody videos were better represented than flat-Earth supporting videos among the million-views videos with 9 (23.1%) of the 39. Thirty-eight videos came from producers with more than one million subscribers to their channel.

One of the methods of indicating support or opposition to the contents of a video is rating it as a like or a dislike. For analysis of both the positive and negative aspects of the like/dislike rating, the present study devised a measure of net favorability (*nf*) calculated as:

$$nf = \left(\frac{likes}{likes + dislikes}\right)(likes + dislikes)$$

This score ranged from 0 to a high of 505,000 with an average of 7045 (*SD* = 30,198). Pro flat-Earth videos (*n* = 301) averaged 1678.4 on this measure (*SD* = 2454) while debunking videos (*n* = 139) averaged 9523.5 (*SD* = 1437). The observed difference between the means for these categories was statistically significant (t [140.7] = -5.434, $p < .001$, $d = 0.65$) indicating that debunking videos had overall greater net favorability than pro flat-Earth videos.

Flat-Earth videos, anti-science and conspiracies

Research question 3 was interested in what anti-science concepts and conspiracies flat-Earth videos tended to reference. Among the most common claims were the involvement of conspirators who worked to cover up the truth of a flat Earth including governments, the *Illuminati* and Jewish groups (79.7%, *n* = 240). The videos also frequently challenged established math and science (75.1%, *n* = 226) claiming that material taught in science classes or printed in textbooks was false. Among the more specific claims were 41.2% (*n* = 124) of the videos arguing that the moon landing and other information and images from NASA are fake; 33.9% (*n* = 102) claimed the existence of a firmament dome (a transparent dome or sphere covering the Earth); 25.2% (*n* = 76) claimed that science is a religion or a method of brainwashing; 20.3% (*n* = 61) argued that an ice wall exists around the perimeter of the flat Earth; 14.3% (*n* = 43) of them claimed that gravity is fake; 12% (*n* = 36) claimed that satellites are fake. Smaller portions of the total offerings claimed that space itself is fake (9.3%, *n* = 28) or argued for the existence of "space bubbles" (8%, *n* = 24).

Flat-Earth versus debunkers on science

Since flat-Earth arguments run counter to established science and overwhelming evidence, videos that seek to argue the case for a flat Earth need to negate (or at least attempt to negate) centuries of scientific evidence and even science itself. The present

study therefore hypothesized (H1) that flat-Earth videos on YouTube are more likely than debunking videos to make broader claims about the fallibility of science. The present analysis tested this hypothesis using a simple scale devised for this purpose in the present study which summed three content variables. This fallibility of science scale counted: 1) references to established science being a religion, cult or conspiracy, 2) the use of general claims that science was unreliable or otherwise not to be believed, and 3) proposal of alternative models to supplant existing science. A score on all these binary coding dimensions would result in a maximum value of 3 on the scale while no mention of these resulted in 0 on the scale.

The mean score on this measure among flat-Earth videos ($n = 301$) was 1.07 ($SD = .69$) while among debunking videos ($n = 139$) it was .02. The observed differences between these means was significant (t [353.14] = 25.12, $p < .001$, $d = 2.1$) indicating that, as may be necessary in this context, flat-Earth videos were more likely to claim that science is fallible than debunking videos. On this point, it should be noted that the positive scores from debunking videos reflected the existence of some (often self-reflexive) critique of science or the scientific method within debunking discourse.

Debunkers and science

Hypothesis 2 (H2) proposed that debunking videos would make greater use of scientific proofs than flat-Earth videos. A binary measure coded whether a video featured any direct reliance on established math or science. The distribution of this measure indicated that 14 of the 301 pro-flat-Earth videos (4.65%) used established math and science compared to 87 of the 139 debunking videos in the sample (62.59%). Analysis of this distribution confirmed that the observed differences in this sample were greater than could be accounted for by chance (X^2 [1, $N = 440$] = 180.5, $p < .01$, $V = 0.64$), supporting this hypothesis for the sample data.

Ideological associations

Religious associations. Hypothesis 3a proposed that flat-Earth videos would be associated with pro-religion expressions. 119 of 119 (100%) pro-flat-Earth videos referencing religion did so in a positive manner. Among the 6 debunking videos that mentioned religion, 4 (66.6%) did so in a positive light while 2 (33.3%) made negative mentions. This distribution reflects a much greater tendency to religious thought among

flat-Earthers and differences in religious attitudes between flat-Earthers and debunkers due to significantly more than chance (X^2 [1, N = 125] = 40.3, p < .01, V = 0.57). This finding supports hypothesis 3a for the given sample data. Additionally, some evidence of pro-religious thinking could be found among the comments such as one poster (Jelly Bean, 2018) who offered the following:

I love living on Gods (*sic*) beautiful flat earth... my relationship with Jesus has grown so much since I discovered this amazing truth :)

Political associations. Hypothesis 3b proposed that flat-Earth videos would be associated with conservative political views. Coding in the present research sought to identify specific explicit conservative sentiments or statements within the video content. This proved relatively rare as only 9 videos (2%) of the 440 combined total of flat-Earth and debunking videos made specific or explicit positive reference to conservative views. All these indications came from flat-Earthers. While this distribution was significantly different from that expected by chance (X^2 [1, N = 440] = 4.24, p = .039, V = 0.1) within the present sample, it also indicated that (at least explicitly) political views were not a particularly popular component of the flat-Earth discourse in the YouTube videos sampled.

Reliance on social media

Hypothesis 4 suggested that flat-Earth videos would be more likely to cite other social media as support for their views than debunking videos. All 36 videos in the sample that used social media for support were flat-Earth videos. This number represented 8.2% of the total of flat-Earth and debunking videos (N= 440) and the observed distribution was significantly different from that expected by chance (X^2 [1, N= 440] = 18.1, p < .01, V = 0.2). This finding supported hypothesis 4 and an association between social media support and flat-Earth videos in the specific case of the sampled data and a small to medium effect size.

Flat Earth and other conspiracies

Hypothesis 5 proposed a correlation between flat Earth claims and general conspiratorial ideation. The total of all flat-Earth claims made in each case was summed into a flat-Earth claim index. This included all claims of the existence of firmament domes, ice walls, and all other flat-Earth ideas. Drawing from prior literature, the present

research proposed that these claims would be correlated with levels of general conspiratorial ideation as measured on a summed scale of general conspiratorial notions appearing in the CMQ (Bruder, Haffke, Neave, Nouripanah, & Imhoff, 2013). Bivariate correlation analysis indicated that levels of flat-Earth claims were indeed strongly and significantly positively correlated with general conspiratorial ideation ($r[500] = .593$, $p < .01$). It is worth noting here that, given the context of this research where direct or probe questions were not possible, mentions of items on the general ideation scale were relatively infrequent with only 144 of the 500 cases demonstrating any of the ideas and only 35 cases referencing all five items.

DISCUSSION

The findings above indicate a preponderance of flat-Earth videos on Youtube.com in comparison to debunking videos. In the current sample, videos supporting the notion of a flat Earth outnumbered debunking videos more than two to one. While this may reflect on the enthusiasm of flat-Earthers, it may also indicate that their zeal is not quite matched among globe-Earthers who, with the full force of history and science at the ready, probably see little point in trying to respond to flat-Earthers. The frequency of flat-Earth videos may reflect an increasing interest in the notion of a flat Earth but may also reflect something of a fad and the willingness of content producers to capitalize on the popularity of the idea.

Flat-Earth enthusiasm was evident in the greater numbers of flat-Earth videos, in their significantly greater length (almost double that of debunking videos) and in their almost three times greater average number of views. These disparities may be related to other factors such as the possibility that greater numbers of users may be drawn to the flat-Earth claims for their shock or entertainment value not typical of the more mundane explanations of Earth's curvature in debunking videos. Influential YouTube producers with large followings may also account for some of the traffic to flat-Earth video channels by their vey mention of the topic or by drawing attention or linking to specific videos. Despite flat-Earth videos enjoying impressive margins in frequency, duration and views they fared much worse in terms of the relative numbers of likes to dislikes. On the scale of

net favorability, debunking videos enjoyed almost six times higher ratings than flat-Earth videos.

The present findings support earlier work on conspiracy theories such as that of Bruder et al. (2013), Garwood (2007) and Wood (2017) that have associated such ideation with science denial and adoption of broader conspiracy thinking. Flat-Earth videos demonstrated a much higher propensity to deny science and to veer off into broader conspiratorial claims. These two tendencies are related since excursions into the conspiratorial are necessary to make a case for a flat-Earth that requires falsification of vast bodies of scientific knowledge and to argue that powerful forces have acted to suppress the truth over many centuries. To further bolster this claim, the findings above suggest that flat-Earth videos also promote the idea that science itself is fallible, false and based on ideological conditioning rather than fact. In doing so, flat-Earth videos eschewed scientific evidence and proofs in favor of what some referred to as "zetetic" methods or reliance on simple observations while also favoring social media sources such as other YouTube videos for support.

Claims of *Illuminati* control and Antarctic ice walls may be appealing as entertainment for some users. Comments in the present study suggest that, for others, these claims appear to provide affirmation of anti-authoritarian sentiments and comfort for those disaffected by mainstream social norms. Some videos suggested extreme variations on these notions with one flat-Earther, for example, expressing concern that aircraft overhead may be sky demons intent on following or observing him.

Ideological associations

Sky demons aside, the present findings indicated that religion played a role in flat-Earth discourse with videos and comments referencing religious scripture to argue for the existence of a firmament dome and the separation of the sea and sky in keeping with previous studies (Everhart & Hameed, 2013; Jacques, 2006; Pobiner, 2016) that found religious views to be associated with science denial. Some video producers and commentators took the perceived suppression of the truth of a flat-Earth as evidence that science and the mainstream in general were also involved in suppressing the truth of (usually) Christian religious doctrines and literal interpretations of Biblical scriptures.

The notion that flat-Earthers would be associated with conservative political views was based on prior research that indicated a greater propensity toward science denial amongst conservatives (Charles, Polis, Sridhara, & Blum, 2008; Elsasser & Dunlap, 2013; Hofstadter, 1970; Mooney, 2005). This idea found some limited support in the present study, but in quite small numbers that make definitive conclusions problematic. Further, since the measure used to evaluate this question was a non-parametric one, it is impossible to draw conclusions outside of the study sample. For these reasons, this question remains open for further study.

CONCLUSION

The study of any social media content is rife with challenges–including the question of motivation. With pressures to achieve views, subscribers and likes (potential sources of income) some producers may create content meant to titillate and create buzz rather than to engage in authentic debate. The answers derived in the present study are conditioned by the possibility that much of the content might well be cleverly designed clickbait, intended to draw viewers and generate controversy. What remains, however, is a corpus of content that serves to challenge established science and to encourage disparagement of learning, evidence and expertise. Ironically, this promotion of anti-science and denigration of scientific inquiry occurs on a platform which owes its foundational technologies to scientists and a spirit of disciplined, collaborative investigation.

The proliferation of flat-Earth videos, whether intended as earnest discourse or as baseless entertainment, may be taken in the context of a larger anti-science movement with important social and political ramifications. The future of important issues such as climate change, medical care and other science-based debates may face the impact of anti-science as a source of resistance to legitimate scientific progress. To the extent that flat-Eartherism as manifest in YouTube videos may have some role in this emerging polemic, the current insights are but a start. Fully embracing these complex issues will require further investigation into dimensions such producer motives, user attitudes and audience effects. An immediate extension of the present research, for example, will be a quantitative content analysis of user comments for evaluation of science denial and

conspiratorial ideation. Further research may also focus on the audiences for this and other conspiratorial content to examine their use of this material and its consequences.

References

Alexa.com. (2017, November 8). *The top 500 sites on the web.* Retrieved November 8, 2017, from Alexa.com: An Amazon.com company: https://www.alexa.com/topsites

American Physical Society. (2006). This month in physics history June, ca. 240 B.C.: Eratosthenes measures the Earth. *APS News, 15*(6). Retrieved from https://www.aps.org/publications/apsnews/200606/history.cfm

Banerjee, S. (2018). Analysis of user-generated comments posted during live matches of the cricket world cup 2015. *Online Information Review, 42*(7), 1180-1194. doi:10.1108/OIR-01-2017-0015

Brown, P. G. (2008). Choosing Ignorance within a Learning Universe. In B. Vitek, & W. Jackson (Eds.), *The Virtues of Ignorance: Complexity, Sustainability, and the Limits of Knowledge* (pp. 165-188). Lexington, Kentucky, USA: The University Press of Kentucky.

Broxton, T., Interian, Y., Vaver, J., & Wattenhofer, M. (2013). Catching a viral video. *Journal of Intelligent Information Systems, 40*(1), 241-259. doi:10.1007/s10844-011-0191-2

Bruder, M., Haffke, P., Neave, N., Nouripanah, N., & Imhoff, R. (2013). Measuring individual differences in generic beliefs in conspiracy theories across cultures: Conspiracy Mentality Questionnaire. *Frontiers in Psychology, 4*(1). doi:10.3389/fpsyg.2013.00225

Carney, T. F. (1972). *Content analysis: A technique for systematic inference from communications.* Winnipeg: University of Manitoba Press.

Carpenter, W. (1885). *One hundred proofs that the Earth is not a globe.* Baltimore: William Carpenter.

Carpentier, N., Dahlgren, P., & Pasquali, F. (2013). Waves of media democratization: A brief history of contemporary participatory practices in the media sphere. *Convergence, 19*(3), 287-294. doi:10.1177/1354856513486529

Charles, V. E., Polis, C. B., Sridhara, S. K., & Blum, R. W. (2008). Abortion and long-term mental health outcomes: A systematic review of the evidence. *Contraception, 78*(6), 436-450. doi:10.1016/j.contraception.2008.07.005

Cook, J., Ellerton, P., & Kinkead, D. (2018). Deconstructing climate misinformation to identify reasoning errors. *Environmental Research Letters, 13*(1), 1-7. doi:10.1088/1748-9326/aaa49f

Copernicus, N. ([1543] 1976). *On the revolutions of the heavenly spheres.* (A. Duncan, Trans.) New York: Barnes and Noble.

Crisp, W. (2018, April 30). United in the belief that Earth is not a globe; More than 200 flat Earth conspiracy theorists gather to discuss their 'proof ' at first UK convention. *Daily Telegraph*, p. 12.

Doerksen, C. J. (2005). *American Babel: Rogue radio broadcasters of the jazz age.* Philadelphia: University of Pennsylvania Press.

Douglas, K. M., Sutton, R. M., & Cichocka, A. (2017). The psychology of conspiracy theories. *Current Directions in Psychological Science, 26*(6), 538–542. doi:10.1177/0963721417718261

Elsasser, S. W., & Dunlap, R. E. (2013). Leading voices in the denier choir: Conservative columnists' dismissal of global warming and denigration of climate science. *American Behavioral Scientist, 57*(6), 754–776. doi:10.1177/0002764212469800

Everhart, D., & Hameed, S. (2013). Muslims and evolution: a study of Pakistani physicians in the United States. *Evolution: Education and Outreach, 6*(2). doi:10.1186/1936-6434-6-2

Eysenbach, G. (2008). Credibility of health information and digital media: new perspective and implications for youth. In M. J. Metzger, & A. J. Flanagin (Eds.), *Digital Media, Youth, and Credibility, MIT Press, Cambridge, MA* (pp. 123-154). Cambridge, MA: MIT Press.

Fuchs, C. (2011). *Foundation of critical media and information studies.* Abington, MA: Routledge.

Garwood, C. (2001). Alfred Russel Wallace and the flat Earth controversy. *Endeavour, 25*(4), 139-143. doi:10.1016/S0160-9327(00)01386-7

Garwood, C. (2007). *Flat Earth: The history of an infamous idea.* New York: Thomas Dunne Press.

Gauchat, G. (2012). Politicization of science in the public sphere: A study of public trust in the United States, 1974 to 2010. *American Sociological Review, 77*(2), 167-187. doi:10.1177/0003122412438225

Goertzel, T. (1994). Belief in conspiracy theories. *Political Psychology, 15*(4), 731-742. doi:10.2307/3791630

Hampden, J. (1871). Is the world flat or round?: being a correspondence between John Hampden, Esq., of Chippenham, Wilts., and Captain George Peacock, F. R. G. S., of Starcross, Devon. Gloucester: John Bellows.

Hofstadter, R. (1970). *Anti-intellectualism in American life.* New York: Random House.

Jacques, P. I. (2006). The rearguard of modernity: Environmental skepticism as a struggle of citizenship. *Global Environmental Politics, 6*(1), 76-101. doi:10.1162/glep.2006.6.1.76

Jam Bos. (2018, January 23). *Flat-Earth physics: Episode 1.0 - planes flying on a spinning ball.* Retrieved from YouTube.com: https://www.youtube.com/watch?v=MDyaRBGpcbM&lc=UgyHo1FHLWZyNqZhvod4AaABAg

Jelly Bean. (2018, July 15). *The flat Earth awakening on Barcroft TV | Nathan Thompson & ODD TV.* Retrieved from YouTube.com: https://www.youtube.com/watch?v=nZ_BMn4vUkU&lc=UgzFK9WaY4Ufbs2FczN4AaABAg

Jletsaistu. (2018, November 16). *The Great Deception.* Retrieved from YouTube.com: https://www.youtube.com/watch?v=wVEslKy3-RQ&lc=UgwigoOng9pJkZ8HrEh4AaABAg

Johansen, M. S., & Joslyn, M. R. (2008). Political Persuasion During Times of Crisis: The Effects of Education and News Media on Citizens' Factual Information about Iraq. *Journalism and Mass Communication Quarterly, 85*(3), 591-608.

Kelly, D. (2018, January 15). The Earth is round, and other myths, debunked by the flat Earth movement (you read that right). *Los Angeles Times*, p. A6.

Knight, P. (2000). *Conspiracy culture: From Kennedy to the X-fies.* London: Routledge.

Krippendorff, K. (2004). *Content analysis: An introduction to its methodology.* Thousand Oaks, California: Sage.

Kuhn, T. S. (1957). *The Copernican revolution: Planetary astronomy in the development of Western thought.* Cambridge, Massachusets: Harvard University Press.

Lewandowsky, S., Gignac, G. E., & Oberauer, K. (2013, October). The role of conspiracist ideation and worldviews in predicting rejection of science. *PLOS One, 8*(10), 1-11.

Lewin, K. (1947). Frontiers in group dynamics II: channels of group life; social planning and action research. *Human Relations, 1*(2), 143-153.

Lilio, Z. (1496). *De origine et laudibus scientiarum. Add: contra antipodes.* Florence, Italy: Francesco Buonaccorsi.

Loxton, D. (2018). Is the Earth flat? Flat Earthers are back. *Skeptic, 23*(2), 8-13.

Martin, D. (2001, March 25). Charles Johnson, 76, proponent of flat Earth: An iconoclast who trusted his eyes and the bible. *New York Times*, p. 44. Retrieved from http://link.galegroup.com/apps/doc/A72285356/GIC?u=psucic&sid=GIC&xid=40a70aec

Meldrum, S., Savarimuthu, B. T., Licorish, S., Tahir, A., Bosu, M., & Jayakaran, P. (2017). Is knee pain information on YouTube videos perceived to be helpful? an analysis of user comments and implications for dissemination on social media. *Digital Health, 3*(1), 1-18. doi:10.1177/2055207617698908

Metzger, M. J., & Flanagin, A. J. (2013). Credibility and trust of information in online environments: The use of cognitive heuristics. *Journal of Pragmatics Volume 59, Part B, December 2013, Pages 210-220, 59*(1), 210-220. doi:10.1016/j.pragma.2013.07.012

Misra, S., & Stokols, D. (2012). Psychological and health outcomes of perceived information overload. *Environment and Behavior, 44*(6), 737–759. doi:10.1177/0013916511404408

Mohammed, S. N., & Thombre, A. (2017). An investigation of user comments on Facebook pages of Trinidad and Tobago's Indian music format radio stations. *Journal of Radio & Audio Media, 24*(1), 111-129. doi:10.1080/19376529.2016.1252374

Mooney, C. (2005). *The Republican war on science.* New York: Basic Books.

Narayan, B., & Preljevic, M. (2017). An information behaviour approach to conspiracy theories: Listening in on voices from within the vaccination debate. *Information Research-an International Electronic Journal, 22*(1). Retrieved from http://InformationR.net/ir/22-1/colis/colis1616.html

Pobiner, B. (2016). Accepting, understanding, teaching, and learning (human) evolution: Obstacles and opportunities. *American Journal of Physical Anthropology , 159*(1), 232-274. doi:10.1002/ajpa.22910

Post-Gazette and Sun-Telegraph. (1960, June 6). British flat-Earth society secretary "solves" mystery: Missing people are out of this world. *Post-Gazette and Sun-Telegraph*, p. 5.

(Parallax) Rowbotham, S. B. (1849, 1865). *Zetetic astronomy: Earth not a globe.* Bath, UK: S. Hayward.

Sarcastro sarcastro_. (2018, November 15). *The grand deception NASA, a flat-Earth perspective.* Retrieved from YouTube.com:https://www.youtube.com/watch?v=wVEslKy3RQ&lc=UgzaMye6Nj8smLi14qx4AaABAg

Shin, J., Jian, L., Driscoll, K., & Bar, F. (2018). The diffusion of misinformation on social media: Temporal pattern, message, and source. *Computers in Human Behavior; 83*(1), 278-287. doi:10.1016/j.chb.2018.02.008

Shoemaker, P. J., & Voss, T. (2009). *Gatekeeping Theory.* London: Routledge.

Slosson, E. E. (1924). Science teaching in a democracy. *NASSP Bulletin*, 138-147. doi:10.1177/019263652400800123

Smallman, S. (2018). Conspiracy theories and the zika epidemic. *Journal of International and Global Studies, 9*(2), 1-13.

Smithson, M. (1993). Ignorance and Science: Dilemmas, Perspectives, and Prospects. *Knowledge: Creation, Diffusion, Utilization, 15*(2), 133-156.

Sweetpea. (2018, October 1). *Flat-Earther testimony (Steve Matthews).* Retrieved from YouTube.com: https://www.youtube.com/watch?v=-BCEcmXl96I&lc=UgxI2Px5e2dc6v8sLPV4AaABAg

The Amaroc News. (1922, April 9). Chris Columbus was all wrong - says Zion head. *The Amaroc News*, p. 4.

The Coconino Sun. (1921, October 7). No Title. *The Coconino Sun*, p. 4.

The Evening World. (1921, September 29). No law of gravity! Voliva proves it with a brickbat. *The Evening World*, p. 2. Retrieved from http://chroniclingamerica.loc.gov/lccn/sn83030193/1921-09-29/ed-1/seq-2/

Washburn, A. N., & Skitka, L. J. (2018). Science denial across the political divide: Liberals and conservatives are similarly motivated to deny attitude-inconsistent science. *Social Psychological and Personality Science, 9*(8), 972-980. doi:10.1177/1948550617731500

Wood, M. J. (2017). Conspiracy suspicions as a proxy for beliefs inconspiracy theories: Implications for theory and measurement. *British Journal of Psychology, 108*(1), 507–527. doi:10.1111/bjop.12231

Wood, M. J., Douglas, K. M., & Sutton, R. M. (2012). Dead and alive: Beliefs in contradictory conspiracy theories. *Social Psychological and Personality Science, 3*(1), 767–773. doi:10.1177/1948550611434786

World Economic Forum. (2014). *Outlook on the global agenda.* Geneva: World Economic Forum. Retrieved August 22, 2018, from http://reports.weforum.org/outlook-14/top-ten-trends-category-page/10-the-rapid-spread-of-misinformation-online/

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