Science Communication through TED Talks: A Conceptual Replication of Sugimoto and Thelwall

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Abstract
This study uses the latest data and data concepts to replicate and validate Sugimoto and Thelwall's 2013 analysis of the impact of media platforms on scientific and scholarly communication and the dissemination of scientific research. The current study analyzes the use of 1491 TED Talk videos—videos frequently used to communicate scientific research and scholarship—on two platforms: the TED website and YouTube. The results suggest that the impact of the videos on knowledge dissemination was stronger across four metrics than in Sugimoto and Thelwall's study and that art and design videos continue to receive less attention than other types of videos (e.g., science and technology). Also, academic speakers received more comments than other types of presenters. To improve science communication with videos, we offer suggestions drawn from this research to help presenters better communicate science through the use of online videos.

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Résumé
Cette étude recourt à des données récentes et à des concepts sur les données récents pour reproduire et valider une analyse effectuée par Sugimoto et Thelwall en 2013 sur la manière dont les plateformes médiatiques influencent la communication savante et la diffusion de la recherche scientifique. Notre étude analyse l'utilisation de 1 491 vidéos de TED Talk—fréquemment utilisées pour communiquer la recherche et le savoir scientifiques—sur deux plateformes : le site web de TED et YouTube. Les résultats suggèrent que l'impact des vidéos sur la diffusion des connaissances était plus fort sur quatre paramètres clés que dans l'étude de Sugimoto et Thelwall et que les vidéos sur l'art et le design continuent de recevoir moins d'attention que d'autres types de vidéos (par exemple, celles sur la science et la technologie). De même, les présentateurs académiques ont reçu plus de commentaires que d'autres types de présentateurs. Afin d'améliorer la communication scientifique par vidéos, nous faisons, en guise de conclusion, des suggestions basées sur notre recherche pour aider les présentateurs à mieux parler de science au moyen de vidéos en ligne.

Keywords / mots clés : knowledge popularization, scholarly communication, science communication, online videos, TED / vulgarisation des connaissances, communication savante, communication scientifique, vidéos en ligne, TED

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Introduction

Science popularization

Before the 1990s, the dissemination of scientific information to a wide and non-specialist public was limited to newspapers, magazines, journals, radio, television, and lectures (Bentley & Kyvik, 2011; Tomajko & Drake, 1985). These distribution mechanisms were largely unidirectional, impeding public engagement with and discussion of scientific information (Kidd, 1988). Moreover, Kidd suggests that the coverage of science, particularly in television and newspapers, was aimed primarily at arousing public interest rather than providing concrete information and knowledge. Journalists and reporters who prepared scripts for disseminating scholarly information to mass audiences through media other than journals and lectures were mostly non-specialists who did not always have a clear grasp of the research (Kidd, 1988, p. 128). At the same time, scientists were often reluctant to share—and were discouraged from sharing—their research and data with the public for such reasons as: insufficient training in science communication; a scientific reward system that did not put a value on public outreach; peer review constraints on the public dissemination of research; debates in scientific circles on whether publicity-seeking was unethical behaviour; restrictions placed on information flow by institutions; and the influence of media visibility on research funding (Dunwoody & Ryan, 1985).

In recent years, a growing number of studies have explored the status of science communication and popularization, especially in developing countries such as China (Ren et al., 2021), Iran (Farhangi et al., 2019), Mexico (Merino & Navarro, 2019) and Russia (Antonyan et al., 2020). Some studies have examined the popularization of knowledge in the medical sciences (Allgaier, 2020; Lee et al., 2021), healthcare (Zhang et al., 2021), environmental science (Henderson, 2019), the application of information technology and information systems in these three fields (Lee et al., 2021; Zhang et al., 2021), and improvements in policymaking (Henderson, 2019). Fewer studies have investigated knowledge dissemination in psychology (Pierini, 2019) and culture and philosophy (Christian, 2022). These studies suggest that there is a growing interest in understanding how knowledge is disseminated among scientists, governments, and the public, and dissemination has already taken different forms in scientific and non-scientific disciplines.

Online videos and platforms

The internet provides a broad range of channels for informing the public and popularizing science, including blog posts, posts on social media platforms, online videos, video streams, and podcasts (Christian, 2022). Online videos have become a popular web-based audiovisual genre that creates opportunities for interaction between video makers and viewers (Sugimoto & Thelwall, 2013). YouTube, the online video-sharing and social media platform established in 2005, was the second most popular social media platform in 2021, with 2 billion unique users and 5 billion videos watched per day (GMI Blogger, 2022). It hosts an abundance of professional and user-generated videos. As for TED, it has become one of the most effective nonprofit producers of online videos for the popularization of scientific and technical knowledge. TED began in 1984 as a conference that gathered professionals, innovators, scholars, and artists in the areas of technology, entertainment and design (T.E.D.); it was held twice a year or sometimes more frequently (El Miedany, 2019; TED, 2022). The purpose of the TED

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Talks offered at these conferences was to share "knowledge that matters through short talks and presentations … to inform and educate global audiences in an accessible way" (TED, 2022). The TED Talks website was launched in 2006 to host videos of conference presentations. These videos were supplemented with transcripts, translations into numerous languages, comments, and blogs, thereby creating "a new spoken web-based genre" (El Miedany, 2019, p. 329). Some TED Talks are shared on both the TED website and YouTube to reach a wide lay public.

The literature on the impact of online videos in knowledge dissemination has various foci. Some studies have looked at the relationship between videos' popularity (indicated by the number of views and comments) and disciplines or topics. For example, Thewall et al. (2012) examined how videos with scientific, technological, and educational content elicit lively audience discussions in the form of comments and replies. They found that religion, news, and politics (under the category of education) generate the most discussion while music, comedy, how-to, and style generated the least. In contrast, TED (2022) found that the most-viewed single TED Talk is about education, and the least-viewed one is about music.

Other studies have investigated audience preferences for video genres. Davis et al. (2020) tested the effects of online expository narration and infotainment videos on viewers' preferences and knowledge acquisition. They found that viewers like and believe traditional and professionally generated expository narrations more than the modern, user-generated infotainment version of videos, regardless of their language, age, gender, and online viewing habits. This observation is supported by Boy et al. (2020), who found that the narrative explanatory video genre performed effectively in knowledge transfer and attracted viewers' attention, increasing their interest and motivation. The expert-created content helped to support the lecturers' credibility and to deliver specialized knowledge, which increased the reliability of the video content and thus viewers' confidence in the video. However, viewers who had not studied at university preferred the infotainment version to the expository one; they had clearer memories of the content after watching the infotainment video (Davis et al., 2020). Viewers with lower educational levels can find it difficult to understand and retain knowledge presented by experts unless it is simplified through an infotainment approach (Boy et al., 2020). Davis et al. (2020) therefore recommended that scientists and academics raise public understanding of science by using infotainment-style narrations with user-generated content—a genre that combines features preferred by viewers on online platforms such as YouTube.

Some research has explored academics' perception of science communication. Jensen, Rouquier, Kreimer and Croissant (2008) found that academically active scientists engaged in science dissemination activities, although this practice had little influence on their careers. However, more recent studies suggest that it is still beneficial for scholars to gain popularity through science communication via new media (such as Baram-Tsabari & Schejter, 2019; David et al., 2020). With the growth and development of media platforms, Cao et al. (2022) found not only that researchers were using media platforms to increase the exposure of scholarly outputs but publishers and science activists were also doing so. The latter believe that if the scholarly output can gain more

online exposure, it can facilitate conversation and discussion. Similarly, Bentley and Kyvik (2011) suggested that academics with more popular publications published more scientific publications as well and thus had a higher academic ranking. They found that scientific publishing correlated positively with popular publishing around the world and across academic fields, whereas the range of popular science publishing differed among countries and academic disciplines. Even though popular science publishing may benefit a scientist's academic ranking, academics were found to be conservative in general about knowledge popularization and popular publishing. Those who participated in the practice were in the minority. This finding was supported by Thelwall et al. (2012), who found insufficient evidence to prove that academics as a whole had adopted online videos to popularize their research knowledge. The number of citations that academics made to online videos was correspondingly low, although it was rising (Kousha et al., 2012). Howell et al. (2019) examined which group of academics have a better perception in using social media for science communication. They found that it was graduate students who were having a better perception than faculty. Ultimately, there remains considerable room to popularize knowledge, including scientific knowledge, for the non-specialist public.

The current study

Although both TED Talks and YouTube still play major roles in science communication and dissemination, little previous research has compared the impacts of online media platforms with those of traditional scholarly publishing as means of popularizing scientific knowledge. Therefore, this study aims to conceptually replicate Cassidy R. Sugimoto and Mike Thelwall's 2013 study to explore its results by examining the two major platforms for TED Talks, the TED website and YouTube. A summary of the findings of Sugimoto and Thelwall's study can be found in the next section. This study contributed to the field in 2013 by emphasizing the importance of understanding the impact of science communication by scientists and academics on the public and in combating the disinformation disseminated by some politicians and YouTubers. It also offered insights into how scientists and academics could use public channels more sensibly to communicate science.

Context: Sugimoto and Thelwall

Sugimoto and Thelwall (2013) were pioneers in comparing the impact of online videos with that of traditional publications on science communication and dissemination. They examined the complete, ongoing collection of TED Talks hosted on the official TED website and YouTube to illuminate the impact of the videos. A range of impact measurements was used: bibliometric (Google Scholar and Web of Science citations) and webometric (TED metrics, YouTube metrics, Mendeley references, Google Books results and syllabi). Sugimoto and Thelwall found that views of the videos hosted on the TED Talks website (mean, 517,437 views) were higher than any other impact metrics. The next highest impact metric was the YouTube views, with an average of only 99,184 views. The impact metrics for TED Talks in the academic community were even lower, with the highest being online mentions related to academic syllabi (mean, two mentions). All other academic impact metrics (e.g., Google Scholar citations, Google Book Citations, Web of Science citations) were lower than this one. Table 1 is repro-

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duced from Sugimoto and Thelwall. For easy comparison, the means of the relevant metrics from the original study can be found in Table 4 in the results section.

Table 1: Impact metrics comparison of original study

Metric	Minimum	Median	Mean	Maximum	Total	Valid
TED website views	44,441	338,969	517,437	9,946,996	620,406,446	1,199
YouTube views	462	43,311	99,184	3,991,983	111,681,275	1,126
Blog citations (Google blog search estimates)	0	3,120	9,073	441,000	10,905,376	1,202
YouTube Likes	2	485	900	26,591	1,013,231	1,126
YouTube Favorite count	3	299	767	38,139	863,458	1,126
YouTube comments	0	195	368	21,703	414,311	1,126
TED web site comments	8	117	187	5,921	224,629	1,199
YouTube Dislikes	0	34	69	1,456	78,053	1,126
Online mentions related to academic syllabi	0	1	2	50	2,070	1,202
Online mentions in PDF and Word documents	0	0	0	49	592	1,202
Google Scholar citations	0	0	0	75	505	1,202
Google Books citations	0	0	0	18	434	1,202
Mentions in PowerPoint presentations	0	0	0	238	392	1,202
Mendeley readers	0	0	0	30	231	1,202
Web of Knowledge citations	0	0	0	5	47	1,202
YouTube Like proportion	0.260	0.941	0.900	1.000	–	1,126

Note: The table is ordered by the total column. (Sugimoto & Thelwall, 2013, p. 668)

The original study also compared impact metrics for videos on different subject matters, using the categories "Art and Design," "Science and Technology" and "Others." Statistically, science and technology videos had significantly higher levels of impact than art and design videos, based on the number of YouTube comments, TED Talk website comments, and YouTube likes that they attracted. These results are presented in Table 2, which is reproduced from the original study. Readers are reminded that the metrics in Table 2 are medians. A summary of this table is incorporated into Table 5 for readers' easy reference.

Table 2: Impact metrics comparison across disciplines

Metric	Art & Design median	Science & Technology median	Others median	Significance of median differences
TED website views	271,587	325,647	315,559	.221
YouTube views	32,774	47,060	43,710.5	.192
Blog citations	1,810	2,280	2,300	.035
YouTube comments	79	199	202.5	.000000**
TED web site comments	63	112	133	.000000**
Online mentions related to academic syllabi	0	1	1	.001*
Online mentions in PDF and Word documents	0	0	0	.009
Google Scholar citations	0	0	0	.008
Google Books citations	0	0	0	.009
Online mentions in PowerPoint presentations	0	0	0	.772
Mendeley readers	0	0	0	.459
Web of Knowledge citations	0	0	0	.347
YouTube Like proportion	.9108	.946	.9248	.000000**

Notes: The table is ordered as in Table 1 and excludes the secondary metrics not tested for. *Significant at $p = .05$; **significant at $p = .001$ after an $n = 13$ Bonferroni correction to modify the alpha value from .05 to .004, .01 to .0008 and .001 to .00008. (Sugimoto & Thelwall, 2013, p. 669)

The correlations between most metrics were weak (with a correlation coefficient < 0.5), but there was a strong correlation between YouTube views and comments on the one hand ($r = 0.68, p < 0.05$) and TED views and comments on the other ($r = 0.68, p < 0.05$).

TED Talk videos presented by academics had higher metrics in almost all categories than those presented by non-academics, but most of the differences were not statistically significant. The only significant differences in impact metrics were online mentions in PDF and Word documents (with more mentions received for videos narrated by academic speakers) and proportions of likes on YouTube (Table 3, reproduced from Sugimoto and Thelwall).

Table 3. Comparison of impact metrics - Academic speakers and non-academic speakers

Metric	Academic	Nonacademics
TED website views	327,904	321,320
YouTube views	49,660	45,414
Blog citations	2,340	2,246
YouTube comments	223	190
TED web site comments	111	112
Online mentions related to academic syllabi	1	1
Online mentions in PDF and Word documents (acad. higher)	0	0*
Google Scholar citations	0	0
Google Books citations	0	0
Online mentions in PowerPoint presentations	0	0
Mendeley readers	0	0
Web of Knowledge citations	0	0
YouTube Like proportion	.9574	.9271**

Notes: *The distributions are significantly different at $p = .05$; **significantly different at $p = .001$ after an $n = 13$ Benferroni correction to modify the alpha value from .05 to .004, .01 to .0008 and .001 to .00008, using a Mann-Whitney *U* test. (Sugimoto and Thelwall, 2013, p. 671)

Although the study by Sugimoto and Thelwall (2013) provides important evidence for the use of TED Talks and YouTube in science communication, the study was published almost ten years ago and the influence of YouTube and TED Talks, as well as the influence of science communication generally, has changed drastically. Despite being a replication study, the purpose of the current study is not to verify the results produced by Sugimoto and Thelwall but rather to determine how the patterns they observed have changed over the subsequent decade. This study answers the same research questions as the original study:

1. Do the apparent levels of impact of TED Talks vary substantially according to the metric used?
2. Are there broad disciplinary differences in the values of the different metrics?
3. Do the different metrics assess similar aspects of the TED videos? Does the popularity of a video affect the extent to which it is discussed?
4. Do academic presenters elicit a different reaction than non-academic presenters in scientific talks? (Sugimoto & Thelwall, 2013, p. 664)

Methodology

Research design

This study is a conceptual replication of Sugimoto and Thelwall's study (2013). A conceptual replication recreates a study by adopting its most crucial elements (Makel &

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Plucker, 2015). In the current study, two key data sources adopted by Sugimoto and Thelwall were retrieved again (TED videos posted on the TED website and YouTube) to answer the same five research questions. However, this study is different from the original study in two ways. First, this study focuses on only four metrics—the videos hosted on TED Talk websites (two impact metrics) and on YouTube (two impact metrics)—rather than all 15 of the metrics investigated in the original study. These four metrics were among the six most influential ones. One of the other two, citations in blogs, is no longer easily measurable because of the expansion in the number of blogging platforms over the last decade. The sixth of the most influential metrics was YouTube favourite counts; this statistic is no longer available to the public. Second, this study retrieved impact metrics with an online tool and secondary data sources instead of retrieving data directly with online tools. This change was necessitated by alterations in data availability. The next section provides further discussion of this matter.

Selection and organization of videos

In the original study, there was a link to a complete list of TED Talks, but the page now contains listening recommendations for daily TED Talk podcasts. There are also far more TED Talk videos than there were a decade ago, so it was not realistic to expect to obtain a full list of talks comparable to the official list of videos initially available on both the TED Talk website and YouTube (i.e., what Sugimoto and Thelwall obtained). Also, the original research relied on some web crawling tools to obtain data. That approach was not possible in the present study due to constraints on resources. Therefore, this study adopts a more pragmatic approach and considers only TED Talk videos found in several existing data sets.

It is important to reemphasize that this study is a conceptual replication study and the videos included in the current study are not directly comparable to the ones in the previous study. The current study aims at examining the differences in impact at a macro level and the figures can only provide an overall picture for this purpose.

Our first data set was composed of videos posted on the TED Talk site. It resulted from a web scraping project conducted by Miguel Corral Jr. and posted on Github. This data set includes usage data as of May 1, 2020. Corral's project allows private and commercial use of this data set, including modification and distribution. We checked the information in the data set (including title, speaker, views, comments, recorded date, and published date) against the information posted on the original TED Talk website for 5 percent of the videos in the data set. As this study was conducted in March 2022, we could only check if the changes in the video views and comments made sense (e.g., the number of views and comments could not be smaller in March 2022 than in March 2020). Our second data set was created with a web scraping tool available online that allows for the retrieval of video information from YouTube. All metrics in this data set were up to date at the time the data were retrieved (March 5, 2022). We then verified the information (including title, author, views, likes and comments) against the videos on YouTube for 5 percent of the videos in the data set.

These two data sets were merged to create a dataset for analysis that included 1491 videos with 22 variables, including title, speaker, speakers' occupation, tags, publication

dates for each platform, views for each platform, comments for each platform, and likes from YouTubers. We again checked 5 percent of the videos in the merged data set to ensure that the information about the videos reflected that available on TED Talks and YouTube. We followed a convenience-sampling approach, including those videos that were accessible to us. Notably, some videos were included in the first data set but not the second for reasons that were beyond our control. One possibility is that some TED Talk events were posted on the TED Talk website but not on YouTube. It is important to note that there is no easy way to retrieve video information on TED Talks as there is no application programming interface (API) on the website. Also, using the API on YouTube is complex, so employing existing data sets was a viable solution to the research question. Given the verification steps we took, we were satisfied with the sample used to answer the research questions despite its limitations.

Sample of videos

The merged data set includes 1491 videos posted between June 2006 and December 2019. Some popular videos reported in Sugimoto and Thelwall (2013) were included, including *My stroke of insight*, *A 12-year-old app developer* and *Do schools kill creativity?* Using the tags for each video, much as Sugimoto and Thelwall (2013) did, we found that 12.54 percent of the videos were tagged Arts and Design, 32.66 percent Science and Technology, 8.58 percent both, and 46.22 percent Other. Of the speakers, 3.00 percent identified themselves as professors, academics, researchers or scientists.

Measurement of impact

There are numerous ways to operationalize the impact of videos. This study followed the measurement of impact from Sugimoto and Thelwall (2013, p. 664) and operationalized it as the "quantitative online traces of user interaction." Also, this study focused on the two platforms publishing TED videos, the TED website and the YouTube channel. There were five metrics: the metrics for the TED Talk website included views, comments, and likes, and the YouTube metrics included views and comments. Each of the five metrics was converted into an average per year, as described below under "Data processing and cleansing." Considering other metrics reported in the original study was beyond the scope of our study.

Data processing and cleansing

The metrics described above were retrieved directly from the data sets. There could be time lags between the posting of videos on the TED Talk website and YouTube. Also, the date ranges of the two data sets differed. Therefore, the metrics from the YouTube data set are not directly comparable to the metrics from the TED Talk website. To ensure a fairer comparison, we examined the publication date of a video on each platform and calculated the average number per publication year for each indicator. Sugimoto and Thelwall did not follow this practice, but the present authors believe that using an average can provide a better picture of the comparative impact of the platforms. To allow easy comparison with the original study, some results were presented that used this newly computed average, but some raw numbers were used as well. As explained below, outliers were detected and removed based on the needs of each analysis.

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Data analysis

This study examined 1) the general impact of videos with simple descriptive statistics; 2) disciplinary differences with the independent samples *t*-test; 3) correlations between metrics with correlation analysis; 4) the relationship with correlation between video popularity and comments; and 5) differences in metrics between academic and non-academic authors with the independent samples *t*-test. As in the original study, none of the five metrics was normally distributed. The non-parametric versions of the above tests were used for data analysis, including Kruskal-Wallis and median tests, Mann-Whitney *U*-tests and the Spearman correlation. As in the original study, Alpha was set at 0.05. Because this study compared differences across the five metrics, Bonferroni correction was performed to avoid overestimating the *p*-value, as had been done in the 2013 study.

Results and discussion

Level of impact

The first research question involved examining the impact of the videos in the data sets based on the five metrics selected from the original study. To maximize the comparability of studies, the raw number of views, comments, and likes was presented in Table 4 without taking the annual average, and the corresponding figures were retrieved from the original study. Although the original study examined more metrics than the current study does, TED website views remained the most frequent interaction observed in the present study, followed in order by YouTube views, YouTube likes, YouTube comments and TED comments. Even though there are more videos and views between the implementation of these two studies, the average number of views, comments and likes may have increased or decreased. For example, in Sugimoto and Thelwall (2013), the average number of YouTube likes was 900. After nine years, more videos have been added but these latter videos did not manage to accumulate 900 likes, so there is a decrease in the average number of likes. An expected difference between the current study and the original study was that the number of video views on each platform would have increased, which is indeed what happened. Conversely, an unexpected difference between this study and the prior one was that in fact the number of likes and comments decreased on both platforms. This result means that, since the original study was done, more people have been viewing TED Talk videos but fewer have been responding to them.

Table 4: Basic statistics on level of impact

	Mean	
Metric	S&T (2013)	Replication (2022)
TED website views	517,437	2,962,958
YouTube views	99,184	993,380
YouTube likes	900	770
YouTube comments	368	304
TED website comments	187	161

Notes: To make possible comparisons with Sugimoto and Thelwall (2013), the mean score was reported in the table rather than the mean number per year; S&T (2013) = Sugimoto & Thelwall, 2013

Interesting patterns can be identified when examining the results of our study alongside those of the original study. Over the past decade, the overall impact of TED Talk videos on the TED Talks website and YouTube has increased. As indicated by the mean of the metrics in Table 1 (i.e., the absolute number of viewers and commenters), the average number of views per video was higher in the current study than in the original. It is important to highlight that the videos included in both studies are not directly comparable and readers are reminded to pay attention to the patterns and trends identified, instead of the actual increases or decreases.

While it is encouraging to see the increase in average views per video, this may be another example of the "rich-get-richer" effect (Zhou, et al., 2016). Zhou et al. examined only YouTube videos on global warming and climate change, but the "rich-get-richer" effect is relevant in our context as well. Both YouTube and the TED Talks website recommend popular videos to viewers. As a result, some trending videos are recommended more often and thus become still more popular. For example, when a user clicks on a video (e.g., a video in February 2022), a more popular video will be recommended. The average number of viewers per year of videos that are already popular will thus increase substantially over time. This tendency could explain the increase in viewers in comparison with the original study.

Another interesting observation was that interaction with these videos remains low. This result can be explained by research conducted more than a decade ago that found that a high proportion of viewers consume videos passively instead of actively engaging with them (Nonnecke & Preece, 1999). Khan (2016) suggested that some reasons for which viewers may comment (i.e., moving from consuming content to engaging with it) are to seek status, give information, and relax. However, Khan's (2016) study examined YouTube videos in general rather than TED Talk videos specifically. Viewers of TED Talks may not feel the need to seek status or give information and so may behave more like other live audiences by just sitting back and watching. Viewers may simply identify with the audience present at the TED Talk event and imitate its behaviour. Such identification may be one possibility to explain why interactions between the videos and viewers remain low.

Disciplinary differences

The second research question focused on disciplinary differences. The videos in the current study were grouped into Art & Design (AD) videos, Science & Technology (ST) videos, Art & Design + Science & Technology (AD + ST) videos and Others, based on the tags that they were given. This classification aligns with the one used in the original study. Table 5 shows the results of the current and original studies. We found that, statistically, AD videos had significantly lower scores on all five metrics than any of the other types of videos. This means that AD videos were consistently less popular than videos from other disciplines.

Our results were different from those of the S&T study. In our study, the AD videos differed from the ST and Others videos in a wider range of metrics. In the original study, the AD videos were less popular than the Others but not less so than ST videos in certain aspects, such as commenting. Another study published by Thelwall, the second

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Table 5: Level of impact across disciplines

Metric	S&T 2013	Replication—mean					Pairwise comparison between disciplines***
		AD	ST	AD + ST	Others	**Overall	
TED website views	–	705,805	1,078,895	792,044	111,6984	Yes	AD < ST AD < Others
YouTube views	–	86,122	141,313	129,592	183,436	Yes	AD < ST AD < Others
YouTube likes	–	2430	2691	2741	4000	Yes	AD < ST AD < Others
TED website comments	AD < Others * ST < Others*	20	37	25	37	Yes	AD < ST AD < Others
YouTube comments	AD < Others*	117	219	180	270	Yes	AD < ST AD < Others

Notes: * Statistically significant as reported by Sugimoto and Thelwall (2013); ** Overall statistical significance for the Kruskal-Wallis Test (a non-parametric version of one-way ANOVA): $p < 0.01$ (alpha = 0.05/5 = 0.01); ***Only statistically significant results were included in the table; S&T = Sugimoto & Thelwall, 2013; ST: Science and Technology; AD + ST: Art and Design + Science and Technology

author of the original study, found that videos about art were less popular than some science-related videos but not less popular than videos from other disciplines (Thelwall et al., 2012). Thelwall's observations seem to show that the results from the current study are different from those of the previous studies. As Thelwall et al. (2012) suggest, it is hard to draw definitive conclusions on disciplinary differences because it may be the content of the videos rather than the discipline that attracts different audiences. They suggested that some videos may simply go viral despite their disciplinary affiliations. That process, together with other non-disciplinary factors, may have a greater impact than disciplinary factors on the differences identified in this study.

It is interesting to note that, in the current study, the popularity of ST videos and the videos in the Others category did not differ. The art and design videos were simply the least popular ones among different categories in both studies. Again, it may be the nature of the content rather than the discipline that is driving popularity. Erviti and Stengler (2016) examined science communication videos and found that viewers preferred to see "striking, unusual, never-seen-before contents." Even though videos on science and technology can present the latest scientific or technological ideas, other videos can serve the same purpose. For example, *Strange answers to the psychopath test* and *The surprising habits of original thinkers* hint at unusual perspectives. While these videos are not about science or technology, they are among the 100 most viewed videos in the Others category. We might hypothesize that many of the videos in Others are on popular topics of general interest (Thelwall et al., 2012). For example, *My son was a Columbine shooter: This is my story* and *This is what it's like to go undercover in North Korea*, which are related to politics and news, are among the 100 most viewed videos in Others.

Correlation between metrics

In response to the third research question, Spearman correlation was conducted to examine the associations among the four metrics (YouTube comments, YouTube likes, TED Talk comments and TED Talk likes). The correlation coefficients in the current study and the corresponding coefficients from the original study are presented in Table 6. Almost all of the correlations were statistically significant. Among the six correlation metrics that were comparable between the current and the original study, the extent of the correlation had changed substantially (> 50%) in two: the correlation (1) between YouTube views and TED website views; and (2) between TED comments and TED website views. These results are underlined in Table 6. When we assessed the correlations following McHuge (2018), we found that these two pairs were strongly or very strongly correlated in the original study (i.e., correlation coefficient > 0.5) but only moderately correlated in the present study (correlation coefficient between 0.30 and 0.49). A high viewing rate on the TED website was strongly associated with high viewership on YouTube, but a high TED viewing rate on the TED website was only moderately associated with the number of TED comments, despite a strong association in the original study. To explore the third research question further, it is necessary to understand how views and comments are related. The next section provides insights into this subject.

Table 6: Correlation between views and "like" metrics

	Comparison	YouTube views	YouTube likes	YouTube comments	TED comments
YouTube likes	Replication	0.911**			
	S&T 2013	–			
YouTube comments	Replication	0.721**	0.793**		
	S&T 2013	0.681**	–		
TED comments	Replication	0.589**	0.538**	0.618**	
	S&T 2013	0.540**	–	0.728**	
TED website views	Replication	**0.466****	0.602**	0.512**	**0.392****
	S&T 2013	**0.724****	–	0.724**	**0.683****

Notes: ** Statistically significant; Results that are in bold and underlined indicate differences > 0.2 between the results of the original and current studies; S&T 2013 = Sugimoto & Thelwall, 2013

Relationship between video popularity and discussion

The fourth research question investigates the relationship between video views and responses to videos. To further understand the relationships, Table 7 shows how the number of views is related to the number of comments. Viewers were more likely to click "like" on a YouTube video than to comment on a YouTube or TED website video. The same pattern was observed in the original study. The following can contextualize these figures for readers: one "like" was recorded for every 86 views of a YouTube video in the original study while there was one per 56 views in the current study. Thus, there was an increased likelihood that viewers would "like" a YouTube video in the current study relative to the original. However, the number of comments on YouTube and TED website videos decreased; having more "likes" did not necessarily translate into having more comments on the TED website and YouTube in the current study. The tendency

Foung, Dennis, & Kwan, Joanna. (2022). Science Communication through TED Talks: A Conceptual Replication of Sugimoto and Thelwall. *Scholarly and Research Communication, 13*(2). doi:10.22230/src.2021v13n2a429

toward a decrease in commenting deserves further discussion in conjunction with the findings on the differences between academic and non-academic speakers. This discussion follows below.

Table 7: Number of views and comments per view

	S&T 2013	Current study	% Change
YouTube comments per view	0.005049	0.002151	-57.39%
YouTube likes per view	0.011631	0.018002	+54.78%
TED comments per view	0.000436	0.000053	-87.84%

Note: S&T = Sugimoto & Thelwall, 2013

Differences in metrics between academic and non-academic speakers

The last research question bore on whether there were differences in impact between academic and non-academic speakers. In the current study, each speaker was categorized in the data set. Hence, presenters were labelled as academic speakers if they identified themselves as an academic, professor, researcher or scientist. In contrast, the original study verified the affiliations of each speaker to confirm his or her academic status. The current study found that, statistically, videos of academic speakers received significantly more comments than those of non-academic ones on both the TED website and YouTube (Table 8). This result represented a change from the original study, which did not find statistically significant differences between academic and non-academic speakers in any of the five comparable metrics.

Table 8: Level of impact: Academic speakers and non-academic speakers

	S&T 2013	Current
TED website views	No significant differences on any of the metrics	–
YouTube views		–
YouTube likes		–
TED website comments		*Academic > non-academic
YouTube comments		*Academic > non-academic

Note: S&T 2013 = Sugimoto & Thelwall (2013)

The fact that videos from academic presenters received more comments than those from non-academic presenters is interesting, especially since the original study found no significant differences between these two groups of speakers. This finding is all the more noteworthy because, overall, these science communication videos received fewer comments than those in the original study. Most past studies agreed that users prefer professionally produced videos to user-generated videos (Davis et al., 2020; Eastin, 2001). Viewers have more confidence in videos generated by professionals, and an academic presenting herself with an academic title has more impact than one who presents herself without an academic title. Those with a title are perceived to be more trustworthy (Eastin, 2001). A possible reason for this difference is that viewers might want to take advantage of the chance to interact with scientists and researchers if they have not had prior opportunities to do so (Grand et al., 2010). Indeed, online video

platforms are a good place to engage in dialogue with scientists, a situation that encourages comments. Another possible reason for the greater number of comments on professionally generated videos is that some viewers are skeptical about scientists and may feel compelled to offer an alternative opinion by commenting. Shapiro and Park (2015) examined the comment behaviours in online science videos and found that comments tended to be used to express opinions by directing fellow users to other newspapers, magazines, or journal articles. This may be one reason for which there are more comments on videos made by academics.

Summary and conclusions

This study conceptually replicated Sugimoto and Thelwall's study (2013). Our results differ significantly from those of the original study on three main points. We observed a change in the number of views that videos received, more obvious disciplinary differences in video metrics, and a shift toward a greater popularity for videos presented by academics. The differences can be attributed, at least in part, to changes in the science communication landscape and ever-changing behaviours by internet users. It is clear that the context for online science communication has changed significantly since 2013. Such a transformation suggests that a replication study conducted ten years from now is likely to reveal still more changes in the online environment and in how audiences relate to it.

The observed differences between this replication and the original Sugimoto and Thelwall study, as well as the basic findings, have implications for scientists who want to use online videos for science communication. First, the nature of the content seems to play a role in a video's popularity—novel or unusual content can attract more attention. To attract more attention from viewers, scientists producing online videos that have relatively predictable content might explore means to improve their rhetoric and to package their scientific arguments in unique ways. Second, given the competition for viewers' attention, scientists must present themselves effectively to increase the appeal of their science communication videos. For example, they can adopt an infotainment style in presenting science; such an approach may motivate viewers to continue watching. Third, given the finding that videos narrated by academic speakers received more comments, academics could participate in the commenting process themselves to improve science communication. Such participation would enhance the scientific communication process and increase its effectiveness.

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