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MISINFORMATION, CONSPIRACY, AND POLITICIZATION IN DIGITALLY MEDIATED SCIENCE

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Introduction

The internet has fundamentally changed the architecture of scientific diffusion, and with it, the public's relationship with science. New digital publishing technologies, including preprint servers, open access journals, and shadow libraries (e.g., sci-hub), have circumvented many of the traditional gatekeepers of science (Bucchi, 2017). Public access to science is further facilitated by science communicators who post popularized interpretations of scientific research on science blogs and social media sites (Brennen, 2018). And through their own posts and comments, science-engaged publics deliberate over these scientific outputs, arriving at communal, though often distinct, understandings about how science should affect their personal lives (Mede & Schäfer, 2020; van Schalkwyk et al., 2020).

But while these changes have made science more publicly relevant, they have also contributed to a crisis of scientific misinformation. On social media, expert consensus on politicized issues from climate change to vaccination are routinely undermined by both low-quality science and misinterpretations of science (Druckman, 2022). Scientific misinformation refers to “publicly available information that is misleading or deceptive relative to the best available scientific evidence or expertise at the time” (Southwell et al., 2022). During the COVID-19 pandemic, scientific misinformation directly undermined public health policies and produced a measurable increase in COVID-19 related injuries and deaths (Albrecht, 2022). In addition, by presenting scientific actors as incompetent or politically compromised, scientific misinformation about COVID-19

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decreased the overall levels of trust in science among many social demographics (Bolsen & Palm, 2022). In this way, science misinformation may have immediate effects on specific science issues as well as long-term consequences for the ability of science to contribute to public policy (Southwell et al., 2022).

Motivated by these challenges, our proposed panel will discuss how the internet shapes public (mis)understandings of science and explore possible regulatory and design decisions to counteract science misinformation. Our proposed panel consists of three panelists with expertise in communication, information science, and history. Each panelist locates misinformation in at least one node in the digital architecture of science, including the literacy skills of the individual, the production and circulation of flawed science, and the mobilization of scientific counterpublics.

Science Literacy

The challenge of selecting digitally mediated information is compounded by the myriad channels for accessing scientific knowledge. Some of these sources, including preprints and clickbait science journalism, should not be interpreted in the same way as peer-reviewed articles. In “Science Literacy in the Post-Truth Era,” our second panelist describes the development of a science literacy framework designed to help students find reliable information within the “infodemic” of information abundance (Cinelli et al., 2020).

Scientific Controversies

Even before the internet, scientific controversies, or disagreements about the interpretation of a particular set of scientific facts, have generated considerable public attention. In “Scientific Controversies in Digital Publics,” our third panelist describes the role of scientific intermediaries, such as Wikipedia and think tanks, in facilitating scientific controversies by framing scientific facts through disparate epistemic perspectives.

Scientific Retractions

Finally, we will consider the impact of misinformation that arises directly from flawed science. While scientific retractions are intended to correct these types of misinformation, in a climate of scientific distrust, retractions of politicized scientific issues may be ignored or even used as evidence of scientific censorship. In “When Retractions Fail,” our final panelist presents a typology of scientific misinformation that can arise from public mentions of retracted research. The talk will also identify the relative prevalence of each type of misinformation in social media mentions of COVID-19 retractions.

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SCIENCE LITERACY IN THE POST-TRUTH ERA

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Science journalism can inform and influence public health policies and stimulate public debates on topics from sustainability, artificial intelligence, to cloning technologies. However, they can also become a vehicle for spreading science-related misinformation and even disinformation when/if they are misinterpreted, especially when less well-trained journalists and sometimes social media influencers produce 'click-bait' pieces for gain. There were also instances where inconclusive or retracted research articles become headlines: a well-known example is the false reporting of the MMR vaccine as a cause of autism that has influenced the anti-vaccination movements and the current measles outbreak in Europe (European Centre for Disease Prevention and Control, 2024).

The spread of misinformation and disinformation during the COVID-19 pandemic has raised the need for information literacy, digital literacy, and media literacy. The World Health Organization defines an infodemic as "too much information including false or misleading information in digital and physical environments during a disease outbreak that can harm health and undermine public health responses" (WHO, n.d.). These issues become more problematic when the general educated public has limited, if any, understanding as to what it means by terms such as 'peer-reviewed' or 'preprint'. Basic understanding of terms related to academic research and publication practices is fundamental and necessary in tackling science misinformation and disinformation. However, little attention has been placed in *science literacy*, defined as the "familiarity with the enterprise and practice of science" (Snow & Dibner, 2016; see also Howell, 2020).

Science literacy is significant for understanding reports of science-related information in mass and social media and evaluating their credibility and reliability. The following examples demonstrate some of the terms and concepts reported in mass media:

Scientists in Germany claim to have cracked the cause of the rare blood clots linked to the Oxford/AstraZeneca and Johnson & Johnson coronavirus vaccines and believe the jabs could be tweaked to stop the reaction happening altogether. The delivery mechanism means the vaccines send the DNA gene sequences of the spike protein into the cell nucleus rather than the cytosol fluid found inside the cell where the virus normally produces proteins, Prof Marschalek and other scientists said in a preprint paper released on Wednesday. (The Irish Times, 2021)

Early results from a small clinical trial, presented February 17 at the annual meeting of the American Association for the Advancement of Science, suggest that a close relative of the weight-loss drugs Wegovy and Ozempic significantly lessened cravings for opioids in people with opioid use disorder. (Science News, 2024)

Efforts to reproduce the work showed that the enzymes do not catalyze the reactions with the activities and selectivities claimed. Careful examination of the first author's lab notebook then revealed missing contemporaneous entries and raw data for key experiments. The authors are therefore retracting the paper... The announcement is the latest example of the reproducibility crisis facing the sciences. (BBC, 2020)

Science literacy is not only important during a pandemic or a public health crisis. As social media posts and news reports about anxiety, stress, diet, weight loss, birth control, vaccinations, and so on are consumed and shared every day, from Sleepy Girl Mocktail (The New York Times, 2024), Ozempic for weight loss (The New York Times, 2022), to more serious health issues, the general public should be equipped with basic understanding of terms related to research and publication practices. The necessity of science literacy is compounded by the proliferation of preprints and an increasing number of open access articles which can be read, but can also be potentially misunderstood, by journalists and the general public. For instance, over 28,000 preprint articles have been uploaded on medRxiv and bioRxiv since the beginning of the Covid-19 pandemic. While these preprints are valuable for scientists and researchers, the majority have not been peer reviewed and are not suitable for journalistic reports or public consumption.

Further, there is also a need for the public to discern potential commercial and political influences on scientific research (Oreskes & Conway, 2010) and the mechanisms by which false beliefs form and spread (O'Connor & Weatherall, 2019). Ma (2024) argues that the understanding of the scientific process, in particular, how knowledge is produced and published, is vital for combatting science disinformation and misinformation. Science literacy can be considered as a subsidiary of information literacy, but the term is not commonly understood and its practices are not well developed.

The overall aim of the project, 'Science Literacy in the Post-Truth Era', is to develop a science literacy competence framework for undergraduate curriculum. Before working on the framework, there are two main research questions to be addressed:

- 1) How do undergraduate students respond to science-related information on social media platforms and other news outlets?
- 2) Do undergraduate students understand terms such as 'preprint' and 'retraction'?

To answer these questions, we are conducting a study to evaluate undergraduate students' media uses and science literacy. In the first phase of the study, focus groups were conducted with undergraduate students in Autumn 2023. In the focus groups, respondents were invited to respond to a few social media posts and discuss their views about the spread of science misinformation on these platforms. The data analysis is in still progress, while the preliminary observations show that (1) respondents' news sources were primarily social media posts and none of them subscribed to newspapers, magazines, or even podcasts for news; (2) respondents did not respond to the need of scientific knowledge when commenting on social media posts about health or lifestyle;

and (3) respondents did not highlight terms such as 'preliminary study' and did not indicate the possibility of science misinformation or disinformation. In the second phase of the study, a survey will be conducted in late Spring 2024, including questions about media use, news sources, and some test questions about science literacy. The design of the survey is informed by the preliminary findings of the focus groups as well as previous surveys such as the European Union Media & News Survey 2023 and The General Social Survey 2022. The survey will be promoted to undergraduate students using social media campaigns and posters and flyers on university campuses in Dublin (Ireland) including Dublin City University, Trinity College Dublin, and University College Dublin.

In the presentation, I will discuss the preliminary findings of the study. I will also discuss the challenges of tackling science misinformation and disinformation when scientific research is under commercial and political influences and when scientific findings are misinterpreted and manipulated.

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THE ITALIAN 'STOP5G' REFUSED KNOWLEDGE COMMUNITY ON SOCIAL MEDIA BEFORE AND DURING THE PANDEMIC

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The proposed talk delves into the Italian Stop5G movement, aiming to explore how this Refused Knowledge Community (RKC) before and during the pandemic crisis employed media - and in particular social media – in their overall discursive practices to construct, stabilize, and, in some instances, radically transform a body of shared knowledge rejected by the majority of the scientific community, concerning in particular the existence of long-term effects of non-ionizing electromagnetic radiations.

For this end, it adopts a perspective inspired by the Social Worlds Framework (Clarke & Star 2007) and by an ecological understanding of media (Anderson 2016). The former conceives social worlds (a plurality of actors sharing the similar positions within a confrontational discursive arena) and their discourses as co-constructed, and drives scholars to address the process of their mutual constitution focusing on specific situations of discursive production; the latter conceives the mediascape as a vast interconnected environment of interactions between human actors and non-human actants (like social platforms' intermediation algorithms), where discourses coevolve in different ways: sometimes competing, sometimes adapting one to the other, and sometimes again merging in new ones.

Under a methodological point of view, the proposed talk is based on a two year long mixed-method empirical research, that included one year of virtual ethnography and of traditional offline ethnographic observation (spanning from 2019 to 2020) of the Stop 5G social world main online and offline activities; analysis of the documents produced by several actors of the RKC; in depth qualitative interviews with citizens, activists, and experts; and focus groups with diverse population samples, including students and adult laypeople.

Thanks to this approach, it was possible to identify four distinct phases characterizing the social world of the Stop5G movement, its discursive practices and uses of media, and its shared knowledge:

- 1) A first phase, the phase of public appeals (2017-2018), when the social world was predominantly composed by networks of dissident scientists contesting the established knowledge on electromagnetic fields. Pursuing a strategy already employed in contesting earlier generations of mobile communication technologies, these scientists utilized public appeals to various institutions and the general public, invoking the precautionary principle to advocate for a moratorium on 5G deployment. At the same time, scientists aimed at opening a controversy within the scientific community over the existence of long-term effects of 5G technology. A linchpin of this strategy was represented by what can be defined as a “scientific patchwork discursive approach”, consisting in the production and circulation of extensive literature reviews collecting scientific

papers, all published in peer-reviewed journals however often deemed unreliable by the larger scientific community, to support the existence of long-term effects attributed to 5G.

- 2) A second phase, the activist phase (2018-2020), when a plurality of laypeople joined the social world as activists, getting organized in a constellation of local independent groups, managing their online and offline activities through instant message applications and Facebook groups, and finding an overall informal coordination in trans-local and national Facebook groups. However independent, these groups by and large aligned their discursive strategies with the “scientific patchwork discursive approach” introduced by scientists in the previous phase: they leveraged scientific literature to engage in dialogues with local municipalities, often resulting in successful appeals for the suspension of 5G deployment. Collaboration with local scientists and alternative knowledge authorities, such as the Italian Association of Electrosensitives (AIE), lend credibility to their requests and helped local groups to maintain their discourses within the borders of a scientific epistemological framework.
- 3) An intermediate phase, at the onset of the pandemic crisis (February-April 2020), during which the social world experienced significant transformations in its discursive practices. Activists’ activities, in fact, shifted mainly online due to lockdown measures, making local online spaces less relevant in favour of few translocal and national Facebook groups. In this phase, online groups moderators engaged in harsh boundary work in the attempt to maintain the focus of their discursive production on 5G technologies, avoiding at the same time anti-scientific and conspiratorial stances.
- 4) The pandemic phase (until the end of 2020, when observation came to an end), when moderators ceased their gatekeeping activities and the discourses in the social world took by and large a populist and conspiratorial turn, and a new “syncretic patchworking discursive approach” became dominant, bringing together alternative scientific knowledge on electromagnetic waves and considerations on alternative spirituality, cultural critic and esoterism, conspiracy theories and claims on the nature of the virus, the risks of vaccines and the alarm of an imminent transhumanist turn in western societies allowed by the deployment of the new communicative infrastructure.

As it will be shown, this turn from a “scientific” to a “syncretic” patchworking approach in the discursive practices of knowledge production and of contestation of official science by the Stop 5G RKG was fostered by, and at the same time promoted, radical transformations in the structuration of the social world, ultimately bringing to the disintegration of a large part of it. In this way, the proposed talk intends to contribute to the understanding of the tight intertwinement between the structuration of a social world and of its arena, its discursive practices – media related and not - and the shared knowledge produced by these same practices, with a specific focus on the role played by media, and in particular social networks, in this intertwinement.

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HOW RETRACTIONS FAIL: CONSPIRACY AND DENIAL IN ONLINE ATTENTION TO RETRACTIONS

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2023 was a record-breaking year for scientific retractions. Over 10,000 academic articles were retracted in 2023, nearly tripling the number of retractions issued in 2022 (McKie, 2024). A retraction, according to the Center on Publication Ethics, is a formal statement that completely repudiates the scientific credibility of a research article (Barbour et al., 2009). While the prevalence of retractions may seem high, it likely represents only a fraction of the total number of fraudulent, manipulated, or otherwise illegitimate articles that are deserving of retraction (Marcus & Oransky, 2017). Thus, some scientists have argued that an increase in retractions actually indicates that the system of science is performing as it should (Hilgard & Jamieson, 2017).

But while retractions may not indicate a systemic problem within science, they are a threat to the public image of science in the context of politicized scientific distrust. Ongoing attacks on academic institutions by conservative interests have raised questions about both the competence of key scientists and the incentive structures through which science is produced (Oreskes & Conway, 2010). In the context of politicization, individual cases of retractions are increasingly likely to be interpreted as an institutional crisis within science rather than the isolated failings of individual scientists or journals (Hilgard & Jamieson, 2017). Indeed, science skeptics, including scientists whose articles were retracted, have claimed that the retraction ‘crisis’ is actually a series of attempts from corrupt science publishers to censor unpopular, and generally conservative, opinions (Savolainen, 2023; McCullough, 2023).

The proposed research talk will present my prior and ongoing research on the social context of retractions. In my prior research (Author, Forthcoming) I have developed a typology of retraction-related misinformation by identifying two types of information disorders associated with public mentions of retraction, namely retraction avoidance and retraction cynicism. In my ongoing research, I have also collected a large dataset of roughly 3 million social media posts from Facebook, Reddit, and Twitter/X that link to retracted articles or their retraction notice (hereafter, “retracted article mentions”). For the proposed talk, I will combine the typology of retraction-related misinformation with an empirical analysis of the prevalence of these forms of misinformation.

I. A Typology of Retraction Misinformation

In my previous research I have identified two types of misinformation that can arise from retracted article mentions. First, misinformation can spread from tweets that present the original article as a scientific fact without acknowledging its retraction. As an unambiguous repudiation of an article’s scientific legitimacy, retractions are one of the most important checks on scientific misinformation. However, this check can only exist

when retractions are acknowledged. In academic publishing, authors are expected not to cite retracted papers for reasons unrelated to their retraction (Barbour et al., 2009). Whether this expectation exists on social media, however, is an open question. While recent research suggests that Twitter mentions of retracted research drop off after an article is retracted, the most likely reason is that the retraction comes after the initial attention to an article has been exhausted (Peng et al., 2022; Serghiou et al., 2021). When the retraction of a science article is not acknowledged, discredited scientific research may continue to propagate. Accordingly, retraction avoidant mentions directly undermine one of science's most essential checks against scientific misinformation.

Second, misinformation can spread from tweets that acknowledge a retraction, but frame it as being politically motivated. These tweets employ the rhetoric of science cynicism, an insidious form of scientific misinformation that does not explicitly deny the relevance of science, but instead seeks to diminish it by politicizing the motives of scientists (Oreskes & Conway, 2010). Utilizing science cynicism allows politicized actors to undermine mainstream ideology without committing to falsifiable positions, e.g., by 'just asking questions.' In the context of COVID-19, science cynicism has characterized much of the response to the pandemic among conservative figureheads (Hall-Jamieson, 2021). Science cynicism has also provided the breadcrumbs for the conspiracy-prone to piece together a sinister narrative in which scientists consort with "political elites" who direct the outcomes of their research. Although there is no evidence of this having occurred for any of the retracted COVID-19 vaccine articles discussed on social media, belief in conspiracy theories have nonetheless emerged as one of the key predictors of vaccine resistance (Romer & Hall-Jamieson, 2020, Romer & Hall-Jamieson, 2022).

II. The Prevalence of Retraction-Related Misinformation

To measure the prevalence of the types two misinformation, we collected a list of 13,367 retracted articles between 2017 and 2023 using the publicly available database of retracted articles (*The Center for Scientific Integrity*, 2018). We then used the *Altmetric Fetch* API, provided through a data sharing agreement with the company *Altmetric*, to find social media mentions of each article before and after their retraction (*Altmetric*, 2023). This produced a dataset of roughly 3 million social media mentions of retracted articles found on Facebook, Reddit, and Twitter/X.

Using the text found in the dataset, we performed a content analysis of the social media mentions in the corpus. To do so, my research team has trained a ChatGPT based classifier to determine whether a given mention provided a neutral reference to the retraction (0), avoided the retraction (1), or ascribed cynical motivations for the retraction (2). The model achieved a high performance for measuring both types of misinformation with an F1 classification score of 0.86 for retraction avoidant mentions and 0.81 for retraction cynical mentions.

With the model trained, we are currently undergoing the task of automated coding using GPT-4. To establish expected values, we performed human coding on a sample of 1000 retracted article mentions. Based on the results of this coding, we expect that retraction

avoidant mentions will constitute 24.3% of all mentions, and retraction cynical mentions will constitute 6.1% of all mentions.

Once the full dataset has been coded, we will test a series of analyze the media-related and article-related factors that contribute to the prevalence of both types of misinformation. My research questions and hypotheses are as follows:

RQ1: Does retraction-related misinformation vary by social media platform?

H1a: Twitter/X contains significantly more retraction avoidant mentions than other platforms

H1b: Twitter/X contains significantly more retraction cynical mentions than other platforms

RQ2: Does retraction-related misinformation vary by article subject?

H2a: Politicized research receives significantly more retraction avoidant mentions.

H2b: Politicized research receive significantly more retraction cynical mentions.

III. Conclusion and Greater Significance

By analyzing the relevance of digital infrastructure and subject politicization in contributing to retraction-related misinformation, my research situates the larger effects of the so-called 'retraction crisis' in two of the most significant currents in contemporary science: the digitalization of science (Stafford, 2010) and the politicization of science (Oreskes & Conway, 2010). Taken together, this research will help elaborate on the extent to which these currents contribute to science misinformation, including conspiracy theories, that directly undermine the core practices of science.

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