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An environmental problem in the making: how media logic molds scientific uncertainty in the production of news about artificial turf in Sweden

Ernesto Abalo and Ulrika Olausson

Abstract

This study aims to contribute knowledge about how an environmental issue is discursively forged notwithstanding the prevalence of significant scientific uncertainty. This is done by studying the production of news about artificial turf as a microplastic pollutant in Sweden. Semi-structured interviews were conducted with 15 journalists and editors, public officials, politicians, industry representatives and experts, all involved in the issue of artificial turf. The study shows how media logic, among other factors, informs the interpretations of the uncertainties surrounding artificial turf as an environmental problem and concludes that the power of media logic needs to be considered also in the construction of other scientifically charged issues.

Keywords

Environmental communication; Representations of science and technology; Science and media

DOI

https://doi.org/10.22323/2.22010201

Submitted: 14th March 2022
Accepted: 20th September 2022
Published: 9th January 2023

Introduction

Over the years, quite a few media studies have convincingly demonstrated that scientific uncertainty is not only a problem for the decision-making capacity of policy makers but that it also poses problems for the news media when they are reporting on scientific and environmental matters [Hansen, 2010; Lester, 2010; Lidskog & Olausson, 2013; Peters & Dunwoody, 2016]. At the core of this problem lie the different logics reigning in the media and in science, respectively, and how these logics shape the mediation of issues that are heavily dependent on science in order to become "real". Environmental risks and crises constitute illustrative examples of this dependence since they often are out of reach for the human senses and thus require the tools of science to be made comprehensible and manageable. However, as Olausson and Berglez [2014] argue, whereas science is inherently characterized by slow processes and uncertainty, the media is characterized by speed and a need for information that is certain and unambiguous. This epistemic difference between science and the media to a large extent complicates the

communication of environmental issues and could lead to a) an absence of news reporting on the issue at hand, b) downplaying of scientific uncertainty in the coverage to instead make room for "the facts", or c) exaggeration of conflicts between scientists.

More precisely, research has pointed out the diverse and dynamic handling of scientific uncertainty by the news media [Peters & Dunwoody, 2016]. For example, in relation to the reporting of nanotechnologies, scholars have found that, depending on the context, the media give low priority to uncertainty [Cacciatore et al., 2012], whereas, in other contexts, they stress uncertainty [Anderson, Allan, Petersen & Wilkinson, 2005]. Similarly, in climate reporting, uncertainty is downplayed in some (national) contexts [Olausson, 2009], while the media's ambition to maintain a balance of opinions can spur the accentuation of uncertainty in others [Boykoff & Boykoff, 2004]. One reason for this variation could be differences in the interpretations of the well-established journalistic objectivity ideal [Deuze, 2005], where emphasis is placed either on "balance", that is, voicing all sides of an issue, or on "truth", that is, providing reliable information pertinent to a given truth [Schudson, 1978]. Another reason for the context-dependent variations in the media's handling of scientific uncertainty might be compliance with the political climate of the country in which the media operate [Olausson, 2009]. Scholars have also shown that the intention of the individual journalists to highlight uncertainty depends on, for example, how other media cover an issue, and on perceived audience expectations [Guenther & Ruhrmann, 2016]. Moreover, journalists seem to deal with uncertainty in different ways, which are tied to how a story is typologized in the newsroom [Lehmkuhl & Peters, 2016].

Obviously, the media's handling of scientific uncertainty is also related to reporters' choice of sources when reporting on the environment. Research clearly shows the media's dependency on experts [Hansen, 2010; Lester, 2010; Lidskog & Olausson, 2013], and the ways in which experts communicate (un)certainty are reflected in the coverage. Allan [1999] argues that the idea of a bureaucratic and hierarchic society is more or less built into the journalistic routines, and sources are selected on the basis of their perceived credibility in terms of position in society. This means that experts and public officials tend to become "primary definers" of environmental issues because they easily get news space. Peters and Dunwoody [2016] argue that the ways these primary definers communicate uncertainty is strongly related to their expectations of the audience. Similarly, Post and Maier [2016] show that the sources' communication is to a great extent interest centered, uncertainty is highlighted or omitted depending on what they want to achieve. For example, a researcher may highlight uncertainty to stress the need for more research funding, an industry representative may point to uncertainty to downplay business-caused environmental effects, and a politician may tone down uncertainty to justify a specific policy.

In short, the now substantial body of literature on the relationship between scientific uncertainty and the news media is focused on how uncertainty is dealt with in media content and on how production factors and sourcing strategies shape the communication of uncertainty. This literature has highlighted two main consequences in the news reporting: that environmental hazards are a) wrongly neglected through the media's emphasis on scientific uncertainties despite these uncertainties being marginal [e.g. Boykoff & Boykoff, 2004]; or b) rightly

highlighted by the media's downplaying of scientific uncertainties because these uncertainties are marginal [e.g. Olausson, 2009].

But what if scientific uncertainties are significant, and the news media forge an environmental problem to report on regardless of these uncertainties? This was the case with artificial turf as a potential disseminator of microplastics in Sweden. A survey study on sources of microplastic pollution in the Swedish aquatic environments [K. Magnusson et al., 2017] showed that artificial turf playing fields were the second largest source of microplastics. However, this study was fraught with uncertainties as the actual effects of artificial turf on marine environments was not measured in the survey. As demonstrated by Abalo [2019a], the Swedish news media handled the many uncertainties ambiguously, and artificial turf was depicted as more or less an established environmental problem. The present study aims to contribute knowledge about how scientific uncertainties were molded, that is, how they in various ways — intentionally or not — were shaped, negotiated, or omitted — in the production of news on artificial turf.

The article has six sections, including this introduction. The second section presents a brief background to the case of artificial turf. The third section accounts for the theoretical framework, which includes the interrelated mechanisms of media logic and mediatization, and the fourth section accounts for the interview method and the analytical strategies used. In the fifth section the results are presented, and the final section presents the study's conclusions.

Artificial turf — an environmental issue?

The potential environmental hazards of artificial turf fields have been under scrutiny in Sweden in relation to two concerns: chemical pollution, and, as will be developed in more depth, microplastic pollution in aquatic environments. In both cases, the source of the problem is the rubber granules placed on the fields for performance reasons, which often are produced from recycled tires (so-called SBR granules). In 2006, the Swedish Chemical Agency published a report about chemical hazards related to artificial turf fields. Based on data and results from other reports and surveys, the report finds possible local environmental risks if granules reach aquatic environments. However, the spread of granules is estimated to be limited, and the report also finds a low risk of health problems related to use of the fields. Moreover, the report points to uncertainty regarding health effects but recommends against use of rubber granules from recycled tires [KemI, 2006].

In 2015, the Swedish government commissioned the Swedish Environmental Protection Agency (SEPA) to study potential sources of microplastic pollution in marine environments in Sweden [Regeringskansliet, 2015], something that placed microplastics on the political agenda. IVL Swedish Environmental Research Institute (IVL), an independent institute, was tasked by the SEPA with conducting the study on microplastic sources, and a report was published in 2016, finding tire wear from road traffic was the largest source of microplastics (13,000 tons per year), followed by artificial turf fields (2,300–3,900 tons per year) [K. Magnusson et al., 2016]. An update of the report a year later showed that tire wear and artificial turf remained the top microplastic sources, but with slightly different figures (tire wear: 7,670 tons per year; artificial turfs: 1,640–2,460 tons per year) [K. Magnusson et al., 2017]. A few years later, IVL published a new report, this time concentrating only on artificial turf and rubber granules as microplastic sources. The spread of

microplastics from artificial turf fields was now estimated to be 500 kg per pitch each year [Krång et al., 2019], totaling about 400 tons per year, based on the same number of fields as in the previous reports. This is slightly more than one-tenth of the figure given in the first report.

IVL's estimations are characterized by uncertainty in different ways. In relation to the survey on sources of microplastics in the sea, IVL stresses that their ranking "suffers from a large degree of uncertainty", and that for "several sources suspected to contribute with large amounts of microplastics to the sea, data is so scarce that no estimations on emissions could be done" [K. Magnusson et al., 2017, p. 6]. This could impact the ranking, as some potential microplastic sources were excluded from the survey due to the lack of data. Moreover, there is also uncertainty around the quantity of granules that reaches the sea. IVL indicates that they cannot tell how much microplastic from artificial turfs reaches marine environments, as that falls beyond the scope of the study [K. Magnusson et al., 2017]. The levels of microplastic pollution from artificial turfs were estimated by assuming that the amount of granules spread on the turfs was the same as the amount that was disseminated from the fields each year, with the risk of ending up in the sea. Replenishment is thus equated with loss. So, for one ton of replenished granules, one ton was estimated to have been spread from the fields. The figures were obtained from suppliers of artificial turfs, who provided information on recommended replenishment amounts, and from municipalities that estimated the amount of granules replenished each year. But the actual spread was thus not part of the data but rather was assumed. This means that the actual amount of microplastics being spread from artificial turf fields and reaching marine environments is not known. In the later report, focusing solely on artificial turf fields, a slightly different methodological approach was used — including, for example, granule compaction as a variable that could explain the need for replenishment — resulting in a smaller amount of assumed microplastic loss [Krång et al., 2019]. However, in that study it also remains unknown how much granule is spread to the sea. It is also worth noting that IVL's estimations are much higher than those in other surveys [S. Magnusson, 2018; Regnell, 2019; Løkkegaard, Malmgren-Hansen & Nilsson, 2018], which might have to do with the divergent approaches used [see Abalo, 2019a, for discussion of this]. After the publication of IVL's report on microplastics in 2016, the SEPA has acted in different ways to address the issue, which has involved, among other things, financing research on the environmental impacts of microplastics [Naturvårdsverket, 2021].

Theoretical framework

To understand the media's discursive construction of an environmental problem, one needs to understand what shapes the workings and the reporting of the media. Olausson and Berglez [2014] place the logics of science and the role of uncertainty as contrary to the logics of policy making and the media, where uncertainty instead makes decision making and news reporting problematic. This would imply that environmental issues are molded to fit institutional and professional communicative logics, which in turn would shape how an issue is represented in the news. These communicative logics are distinct but also related, and in this study this connection is theorized through the concepts of media logic and mediatization [Altheide & Snow, 1979; Hjarvard, 2013; Couldry & Hepp, 2013]. We believe that this theoretical lens, will provide explanations of how scientific uncertainties were molded in the particular case of artificial turf, but also

contribute more general knowledge about the workings of the media in connection to scientifically charged issues.

The concept of media logic aims to capture how social reality, when turned into mediated events, is transformed in different ways to fit the general parameters that govern the media and the process of news evaluation. Media logic thus conceptualizes the features, format, styles, focus and grammar of a type of medium [Altheide, 2013, 2020]. Not every phenomenon or process is deemed compatible with media logic, which means that news work constantly entails evaluation and selection among various events and phenomena. These selection practices determine which issues will be brought onto the news agenda and made subject to public attention as well as, in the long run, determined worthy to act upon. A common criterion of news evaluation is geographical/cultural/historical/temporal proximity [Galtung & Ruge, 1965; Harcup & O'Neill, 2017], which means that to become newsworthy, events need to be seen as close to the imagined audience in various ways. Another significant news criterion is the possibility to visualize the topical issue to make it accessible to the imagined audience [Berglez, 2011]. Climate change, as a case in point, was long considered difficult to report on since it did not come with concrete visual elements, but as this issue became increasingly politicized, visual features of its presumed causes and consequences were used in the news reporting to anchor it in familiar contexts [Olausson, 2010].

Media logic not only involves *selecting* events for the news agenda but also *shaping* events to make them fit genre conventions concerning format and style. To this end, the "problem frame" is often deployed to recontextualize a specific event in a conflictual manner to make it newsworthy [Altheide, 1997]. Most news organizations are also commercial enterprises, which means that news selection is not only, or even primarily, based on what could be deemed as societally important but also on what is expected to create audience response, clicks and shares [Deephouse & Heugens, 2009]. Drama or conflict is considered to do precisely that [Harcup & O'Neill, 2017], and the commercial imperative thus leads the media to apply the problem frame [Karidi, 2018].

Moreover, media logic has colonized other social realms, making this logic also prevalent in how communication is organized and executed beyond media organizations, a process called mediatization [Hjarvard, 2013; Couldry & Hepp, 2013]. Corporations, public authorities and other types of organizations experience a need to adapt to the rules set by the media, something which renders them increasingly mediatized. With the stronger forms of mediatization, identified by Strömbäck [2008], situations where reality is seen through the lenses of the media tend to become more real to organizations than any other forms of reality. This means that media logic influences institutions and organizations indirectly, when they integrate and adjust their own working methods and communication to the logics of media. In this way, media logic evolves into a powerful force extending far beyond the media itself [Grafström, Windell & Karlberg, 2015; Thorbjornsrud, Ustad Figenschou & Ihlen, 2014]. One possible outcome of mediatization processes is that organizations and institutions avoid communicating complexity and ambiguity in favor of issues and angles that are clear-cut and "safe".

However, mediatization is not unidirectional but rather a dialectic process, which also pushes corporations and authorities of different kinds to engage in proactive,

strategic communication to actively manage their reputation and image [Deephouse, 2000] as well as to take on increasingly active roles as news producers. As organizations invest resources in communication and media work, they become powerful forces in influencing both the news agenda and the way various issues, as well as the organizations themselves, are to be publicly displayed through the news media [Grafström & Rehnberg, 2019]. In sum, an important consequence of the news media's strong position in society is that media sources adapt their communication to media logic.

Material and method

This study uses materials from a larger research project about the mediation of artificial turf in Swedish news media, commissioned by Swedish Tyre Recycling (SDAB). The project consists of a content analysis of the coverage of artificial turf [Abalo, 2019b], a discourse analysis of the construction of artificial turf as an environmental risk [Abalo, 2019a], and an interview study on the communication strategies of journalists and stakeholders in relation to the mediation of artificial turf and microplastics [Abalo, 2020]. The present article relies on parts of the materials of the latter.

The materials used in this paper consist of 14 semi-structured interviews [Kvale, 1996] with a total of 15 respondents (13 individual interviews, and one pair interview).

Sample composition:

- 5 journalists and editors. (Working either in local newspapers or in local public service newsrooms)
- 3 officials from the SEPA. (One of the interviews is a pair interview.)
- 2 local politicians. (One from a big city and one from a smaller municipality)
- 2 industry representatives. (One from SDAB and one from an associated communication bureau)
- 3 experts. (Two conduct research within academia and one works in an independent organization.)

The selected sample includes journalists and editors so as to enable exploration of the newsroom's construction of artificial turf as an environmental problem, and it also includes different stakeholders so as to foster understanding of the interrelation between newsrooms and "primary definers". Newsrooms that have reported about artificial turf were included in the sample, as well as stakeholders that are information rich for this specific case. The politicians have publicly addressed the issue of microplastics, and the experts are in different ways experts on artificial turf and/or microplastics from an environmental point of view. It is important to note that the study is not interested in the personal opinions of the respondents on artificial turf and microplastics, but in their experiences and communicative work with these issues.

In the sample, there are eight male and seven female respondents. The interviews took place between January and March 2020. Four interviews were conducted in

person, and the rest online via different applications. All interviews were recorded and manually transcribed verbatim. For this publication, excerpts have been edited slightly to ensure readability. On average, each interview lasted about 50 minutes. Central themes of the interviews were communication work in a broad sense, the communication of information about artificial turfs and microplastics more specifically, the role of expert voices in the media, and the communication of uncertainty. As the interviews are semi-structured, with the ambition of providing a sort of conversation between the researcher and the respondent, an interview guide structured around these themes was used, rather than a strict questionnaire. Given the different roles and occupations of the respondents, this guide was adapted to the role of the specific respondent. The transcribed interviews were subjected to thematic analysis, which is "a method for identifying, analyzing and reporting patterns (themes) within data" [Braun & Clarke, 2006, p. 79]. The theoretically driven analysis sought to identify themes such as different ways of communicating about artificial turf and microplastics, the relation between expert voices and the media, and the communication of science and uncertainty. Theories on mediatization drove the identification of how non-media institutions' adaptation to media logic shaped their communication, and theories on media logic helped in identifying and interpreting the workings of newsrooms in a digital age, and how this shapes the relation between the media and their sources.

Ethical considerations

The respondents were contacted by email, and in a few cases by telephone, and they were informed about the aim of the project. Participants were granted anonymity in the research publications, and personal information was handled with confidentiality. Some participants were also provided complementary information orally during the interview. After the interviews, the participants were given access to their own interview transcripts, which they then had the opportunity to comment on. Additionally, all respondents were given access to the interview study report [Abalo, 2020]. In addition to having participants' names anonymized, some respondents also wanted their organizations to be anonymized, which has been respected. All respondents were informed before their interviews that the research project was funded by SDAB.

This commissioned research project relies on an agreement between Jönköping University and SDAB, which states that the project has no commercial ties that compromise the project's objectivity, independence or openness. The agreement also states that the university has the right to publish results from the project without the consent of SDAB, which warrants that there is no conflict of interests. However, one could argue that there is a risk of bias, or a "consensus of interest", between the funders and the researchers — a possible risk in any commissioned research. However, the guiding interest of the research team has been to explore a rather new phenomenon in relation to environmental communication, that of artificial turf, and the research team has had a great deal of independence when structuring the research project.

Results

The results section is structured in accordance with the analytically generated themes from the interviews with journalists and key sources that show how media

logic informs their interpretations of the uncertainties surrounding artificial turf as an environmental problem. The themes center around media logic and a) the downplaying of uncertainty; b) the importance of visual proximity and national conceptions, and c) the emphasis on the precautionary principle.

The downplaying of uncertainty

The analysis shows that the interviewed experts are very aware of the differences in communicative logics between them and the media, and that they need to adjust to media logic's demands for certainty. As one expert puts it "a media angle surely relies commercially on it being interesting and sellable" (Expert 3),[1] recognizing the commercial impetus of the media [Karidi, 2018]. This feature of news reporting makes it difficult for experts to be upfront about the scientific uncertainty when talking about artificial turf with journalists. Another expert states that "the complexity and uncertainty in research don't fit in an article in *Aftonbladet*" (Expert 1).[2] This expert instead sees opinion pieces as better suited for communicating scientific content. The approach of this expert implies a latent critique against the mediatization of science and especially highlights the difficulty of making science fit the journalistic format [see Berglez, 2011].

Moreover, there is an awareness among interviewed experts that the media's way of addressing environmental issues might impact policy making. One expert sees the expert's role as important, pointing to the risk that "decision makers build their view of things based on a distorted media image" (Expert 2). Another expert sees the positive in exaggerated media reporting, as it can lead to a precautionary stance. However, the same expert says that when things like microplastics are amplified in the media and in politics, "this means that there will be a bunch of calls and soon everybody will have to work with microplastics. When we perhaps think that there are many other more important things to work with" (Expert 3). This expert highlights how the media drive attention to particular issues, while distracting attention from more pressing ones.

In encounters with journalists that are related to the issue of artificial turf, one of the interviewed experts seemingly makes use of specific strategies. This expert sees several risks with expressing too much uncertainty, such as that journalists will interpret uncertainty as danger.

> *You have to be a bit cautious about what you say, because… as it is in research, you cannot answer all the questions. Then it's not unreasonable that this is what is highlighted — that knowledge is lacking, you cannot answer this, and then they tie that to maybe this is very dangerous. And it's a bit difficult to talk with journalists, because… they easily twist things around. (Expert 2)*

In this way, the expert attempts to avoid playing into the hands of the journalists and thereby involuntarily adding to the problem frame [Altheide, 1997]. This same expert claims to avoid painting the world in "black or white", and instead tries to place different environmental hazards in relation to each other. In this way, a

[1] All excerpts have been translated from Swedish by the authors.
[2] *Aftonbladet* is a Swedish tabloid.

ground for discussion where environmental risks are not perceived as a zero-sum game is provided, the argument goes. This suggests a reluctance to communicate to the media the ambiguity that is inherent in scientific practices, which in turn implies a skepticism towards media logic and journalists' ability to interpret facts. However, these mediatization processes, that is, science's adaptation to media logic, risk paving the way for the underestimation of scientific uncertainty in news reporting.

In a similar vein, the SEPA officials clearly acknowledge the uncertainty of the scientific findings regarding the environmental harm of artificial turf, but they also acknowledge how this uncertainty somehow disappeared when the figures related to microplastics spread in wider circles through the media.

> *They [IVL] did the best they could considering that there were practically no data to build upon. Instead, they had to make rather rough estimations and calculations, based on estimations of what one could expect… which everyone was aware of if you properly read what was written in the material. But then, it went further… Figures easily get their own little… If one removes the words "uncertain data", the figures take on their own currency, and that was surely what happened in this case. (SEPA Official 1)*

In this way, scientific uncertainty seems to have faded in the process of SEPA's commissioned communication being disseminated in the surrounding society. The reduction of uncertainty also seems to be connected to a strategy prompted by the expectations of the government to produce clear-cut knowledge as a basis for regulation. The SEPA was, according to the interviewed official, in a way pressured to curb uncertainties by making use of unreliable data to fulfil their mission.

> *…Because when we get government commissions, we try to do what we can with the commission that we've received. We cannot just say "no, there's no data, we won't hand in anything". Because the government had high expectations of what we would achieve… (SEPA Official 1)*

The interviewed journalists also acknowledge media logic's difficulties in handling scientific complexity and uncertainty. One journalist stresses the struggles in dealing with complex issues while attempting to be clear and understandable — to avoid being "fuzzy", in the words of Journalist 4. Journalist 4 emphasizes the importance of sticking to the core of an issue "to make it easy for the reader to understand. Otherwise, you could just as well publish research documents…" The position of the journalist reveals the difficulty of working across genres and communicative logics and the difficulties in making science-related issues fit the journalistic format [Berglez, 2011]. This respondent's answer also exposes a view of journalism as something clear-cut, without ambiguity and uncertainty, which explains the experienced difficulties of fitting science-related issues into the news format. The idea of news reporting as demanding unambiguity also fosters the neglect — or at least downplaying — of scientific uncertainty among journalists.

Moreover, the analysis reveals an instrumental view of science among certain journalists, which could explain why the uncertainty around the environmental hazards of artificial turf was largely relativized in the reporting. One journalist,

who wrote several news pieces about the environmental risks related to artificial turf fields, attributes the lack of counter perspectives in the media to a lack of scientific evidence of any positive environmental effects of artificial turf.

> *But at that time quite a lot of different research was going on about this. And there was, in fact, no research that by then had shown any positive environmental effect from spreading out rubber [granules]. So, there was no such research to contrast it with, as far as I remember. No researcher who said anything else, really. (Journalist 2)*

The journalist thus explains the reporting as based on scientific results, and the lack of scientific results pointing to "positive environmental effects" of artificial turf as legitimizing the chosen news angle. In this sense, the journalist is treating scientific research "journalistically", by trying to find opposing studies that would show the beneficial nature of artificial turfs and microplastics.

SDAB and their communication bureau are deviating from this downplaying of uncertainty; they report that part of their media strategy was contacting journalists who had depicted artificial turf as an environmental problem and providing them with different information on the matter. The ambition was to add nuance to the picture of artificial turf by, among other things, underscoring the uncertainty of IVL's estimations. However, this strategy was unsuccessful, as this information on artificial turf was, with few exceptions, neglected by the news media [Abalo, 2019b, 2019a]. On one level, this suggests that a media strategy like SDAB's that counteracts media logic's quest for certainty and unambiguity will meet considerable difficulties in breaking through. On another level, however, the strategy of SDAB perfectly matches the media logic's quest for conflict, which could have made them an interesting voice in the media. But being an industry actor, it is likely that the newsrooms treated SDAB with some caution, especially in the present national setting that commends itself for taking environmental destruction and hazards very seriously.

The importance of (visual) proximity and national conceptions

In addition to the recognition that media logic entails the need for scientific certainty and unambiguity, proximity to an imagined national audience seems to be of importance when constructing artificial turf as an environmental problem. In this, the journalists draw on their own personal experience of granules attaching "to socks and everything", as expressed in the quotation below, something which is expected to resonate well with national and local audiences engaged in soccer themselves or as parents. This becomes apparent in the interview with one of the journalists, who claims to have become aware of the environmental risks of artificial turfs when watching a soccer game.

> *I believe it was like this. Because I was at [name of the sports arena] and watching a game, early spring or late autumn, I don't really remember. And then I know that I noticed that besides the pitch there were like… well, big piles of black granules. They came from the pitch. And then I noticed that ten meters behind the goal flows [name of the river]. This is not good. And then I think I came across a study somehow and I started to call around…*
>
> *…*

> *I think I reflected that it's crystal clear that they [the granules] reach waterways and the sea. How much… I don't really know. To me, the whole thing was that it reaches waterways. If you've been to an artificial turf pitch yourself, then you know that it sticks to socks and everything. And when you're showering at home… I don't know, it goes down the drain. Is there any filter that captures it, perhaps? I have no idea. (Journalist 3)*

Central in the local journalist's account is the reference to artificial turf fields as a sort of visible and local environmental problem. According to the journalist, this environmental problem can be seen in local fields, where granules are piled and spread outside of the fields, and eventually either end up in the local river or in your shower at home. Important here is how the journalist makes inferences about the environmental hazards of artificial turf fields: the mere existence of piles of granules is transformed into a problem for aquatic environments, and the same goes for the granules that people involuntarily bring home. The visibility of the granules outside the soccer pitch is thus sufficient for concluding that they constitute an environmental problem, and this also helped newsrooms to visually frame stories on artificial turf [Abalo, 2019a].

It was not difficult for journalists with this understanding to find support among their key sources for the proximity approach, that is, the national or local recognition of the very visible problem with artificial turf. One politician explains the spread of granules by putting together a chain of events, which is partly based on personal observations that most likely are shared by a considerable portion of the large soccer community.

> *But I've seen it, because I've had children who played soccer on artificial turf fields. I could see that we brought those tiny microplastics all the way home. And you have to brush off and vacuum so they don't get in the washing machine… So, it does disappear. Perhaps the amount [of granules disappearing] isn't that big, perhaps that's not fair. Possibly. (Politician 1)*

In this politician's view, people bring granules home and must clean up carefully so the granules do not end up in the washing machine, and in the end, in all probability, in the water. Such observations lead the politician to conclude that granules "disappear", although the politician is uncertain to what extent. Nevertheless, and in a similar vein as the journalist quoted above, the personal observations made on a local level substantiate the perception that artificial turf fields spread granules in the environment.

At the same time, the analysis made by the journalist and the politician resonates well with the notion of anti-littering. This conception, which revolves around the idea that littering is bad behavior, is commonplace in Sweden due to the long-standing campaigns "Håll Sverige Rent" [Keep Sweden Clean] and "Håll Naturen Ren" [Keep Nature Clean], which have, from the 1980s prompted Swedes not to litter [Håll Sverige Rent, 2016]. In fact, some other respondents also explain why artificial turf has become an environmental topic in a similar vein. For example, Politician 2 stresses that the visibility of the granules reduces uncertainty, and by seeing "all the granules spread outside [the pitch]" one also in a way is seeing littering. Similarly, Expert 2 underscores this visibility that is connected to the idea of littering, which "is so basic to us in Sweden".

In sum, the analysis shows that journalists and sources alike use their own personal experiences to conclude that granules — which are very visible to the bare eye — are spread to aquatic environments, which can explain why the environmental impact of artificial turf is more or less taken for granted in the reporting. As soccer is a popular sport in Sweden among both adults and children, it is also reasonable to assume that the addressed national or local audience of the news media share similar experiences of the rubber granules from artificial turf. Moreover, such experiences are likely to resonate well with national conceptions such as anti-littering. These ingredients would satisfy media logic's quest for cultural and ideological proximity, as well as its need for visualization. In this way, the media can point to what seems to be an environmental problem, which in turn serves to mold scientific uncertainty.

The emphasis on the precautionary principle

The analysis also reveals the importance of the precautionary principle for the construction of artificial turf as an environmental problem. Arguably, when key media sources highlight this principle in relation to possible environmental harms, media logic's overall quest for a problem frame is satisfied. The precautionary principle can roughly be understood as a "better safe than sorry" approach to potential environmental risks [Pereira Di Salvo & Raymond, 2010, p. 86], and despite the fact that there is little or no consensus on how to interpret and use the principle [Hartzell-Nichols, 2013; Lofstedt, 2014; Wiener & Rogers, 2002], a common definition is the 1992 Rio Declaration, stressing that where "there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used to postpone" actions to prevent environmental harm [Lofstedt, 2014, p. 139].

Expert 3 says that "if you don't know, then you turn to the precautionary principle" to explain the need to identify potential environmental problems despite the uncertain nature of data and results (Expert 3). In a similar vein, another expert alludes to the "safety principle" to communicate the need to act despite scientific uncertainty (Expert 1). This notion of the precautionary principle is in line with its moderate form outlined by Wiener and Rogers [2002], where uncertainty justifies action.

For the SEPA, the precautionary principle in its more aggressive form [Wiener & Rogers, 2002] is important and seemingly legitimized by the government's high expectations for the organization to produce useful and applicable knowledge. Environmental science is "always" uncertain, but this should not hinder precautionary action, the argument seems to go.

> *In the environmental area, it's common for there to be quite a lot of uncertainty. . . . Then there's something called the precautionary principle in the Environmental Code. And then we have an obligation. Because we're responsible for the Environmental Code as a government agency. Then we have an obligation to use it. Which we did in this case. (SEPA Official 1)*

This SEPA official refers to the precautionary principle, as stated in the Swedish Environmental Code, which regulates the work of the SEPA, to explain their actions in relation to the measurement of the spread of microplastics in aquatic

environments and the related communication efforts. The precautionary principle is here tied with what is seen as an "obligation" for the agency. Later in the interview, the same official justifies the publication of uncertain data about microplastic dispersal despite the fact that the IVL's data are perceived as "rough estimations" and continues:

> *And then I rather think like this: it's so good that they [IVL] made a first try and that we also published it immediately. Because we did. We posted it on our website and published it. (SEPA Official 1)*

Here, the official judges it as positive to have published IVL's data, although uncertain. The need for and relevance of publishing uncertain data must here be understood against the backdrop of both the precautionary principle and the state agency's adaptation to media logic. What is important is not primarily rigorous analysis and results but making information available fast. In the case of artificial turf, this had specific consequences. By making uncertain data available and publishing it in accordance with the precautionary principle, the SEPA and affiliated actors gave the media a problem to frame which — at least partly — explains the alarmist depictions of artificial turf in the news media.

In this way, when the precautionary principle is articulated by the media's preferred sources in relation to artificial turf, this provides journalists with the problem frame needed to fit the issue into the news format as an environmental problem. The precautionary principle thus becomes a way to accommodate media logic and to mold scientific uncertainty by disregarding this uncertainty.

Concluding remarks

In sum, the mechanisms that the analysis revealed work forcefully to mold, that is, to in various ways shape, negotiate or omit scientific uncertainty and thereby pave the way for the construction of artificial turf, despite significant uncertainty, as an environmental hazard in the news. A vast body of media research has demonstrated how media logic and mediatization take shape textually, and the current study contributes, above all, knowledge about the production stage. The demands of media logic are primarily satisfied by the following molding tendencies — intentional or not — in the production stage of the news on artificial turf:

a) Unambiguity: the intentional downplaying of uncertainties by experts, officials' efforts to rapidly produce concrete data in order to meet the perceived expectations of the government, and journalists' taken-for-granted view of news reporting as something unambiguous and clear-cut. All of this involve the mediatization of science, where the logic of science as slowly progressing and inherently uncertain is adapted to the logic of both policy [Cairney & Oliver, 2017] and the media [Olausson & Berglez, 2014; Couldry & Hepp, 2013].

b) Geographical/cultural/visual proximity: journalists' as well as their sources' localized personal experiences of artificial turf, which together with the visual character of the rubber granules and the anti-litter conception create a sense of proximity to the imagined audience with similar experiences/conceptions [Harcup & O'Neill, 2017].

c) A problem: key sources' articulation of the precautionary principle, which provides journalists with the problem and fear-inducing frame as required by media logic [Altheide, 1997, 2020] as well as to discursively construct a problem for policy development [Colebatch, Hoppe & Noordegraaf, 2012]

d) Continuity/Follow-up: the rigidity and inertness of media logic, which give priority to subject and frames already in the news. This hinders the news media's negotiation of an established problem frame and deems sources that question such a frame less relevant [Harcup & O'Neill, 2017].

These results at least partly explain the news media's construction of artificial turf as an environmental hazard [Abalo, 2019a] and, above all, prompt the question of what the consequences are of significant scientific uncertainty being molded in these ways by media logic. As Olausson [2009] notes in a study about media representations of climate change, the Swedish news media tend to downplay scientific uncertainty in favor of collective action. Without doubt, this could be considered beneficial when it comes to climate change, where scientific uncertainty about its existence, causes and consequences is minor. Highlighting such uncertainties would create a "bias" [Boykoff & Boykoff, 2004] and be counterproductive for stimulating public engagement since it is well documented that knowledge of scientists' conflicting views about an issue causes people to be reluctant to accept information about the issue [Hornsey, Harris, Bain & Fielding, 2016].

But the opposite also holds true, that is, when scientific uncertainties — through the various molding tendencies noted above — are relativized and turned into almost complete omission, this could have negative implications. The focus on artificial turf, as in the topical case, as a main "villain" could both distract attention from other possible microplastic pollutants and from other sustainability relevant actions. Artificial turf, for instance, actualizes the issue of circular economy, as something needs to be done with the large quantity of worn-out tires. This aspect was, however, mainly neglected by the media [Abalo, 2019b].

The results of this study demonstrate how media logic and accompanying mediatization tendencies become important factors, among others, in the production of news on artificial turf as an environmental hazard despite scientific uncertainty. However, this is a qualitative case study with limited ability of generalization. Thus, the mechanisms pertaining to media logic should also be addressed in research about other scientifically charged issues and situations, not least ones concerning public health.

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Authors

Ernesto Abalo is Associate Professor in Media and communication, and Head of the Department of Communication and Behavioural Sciences, at Jönköping University. His research interest is the relationship between journalism, politics and hegemony, in relation to international relations, drugs, and the environment.

ernesto.abalo@ju.se.

Ulrika Olausson is an affiliated researcher in Media and communication at Jönköping University, and formerly Professor there. She has published extensively on environmental communication, sustainability, and climate change representation.

ulrika.olausson@ju.se.

How to cite

Abalo, E. and Olausson, U. (2023). 'An environmental problem in the making: how media logic molds scientific uncertainty in the production of news about artificial turf in Sweden'. *JCOM* 22 (01), A01. https://doi.org/10.22323/2.22010201.

ISSN 1824-2049. Published by SISSA Medialab. jcom.sissa.it