11 Stories about Villains, Mad Scientists and Failure

Patterns of Evidence Criticism in Media Coverage of Genomic Research

Susanne Kinnebrock and Helena Bilandzic

Media coverage of science is double-edged. On the one hand, journalism is expected to cover science as objectively as possible: Science journalists should select new and important findings and present them correctly to their non-expert audiences. On the other hand, journalists are expected to transform findings and their evidence according to media logics and the common sense of a public at large.[1] As a result, complex scientific findings and evidencing practices become transformed into news stories that are supposed to be easy to understand and even entertaining.[2]

The word "story" already indicates that the transformation of scientific findings into understandable news items is mainly a process of narrativization in which archetypical protagonists (e.g. villains or mad scientists) as well as archetypical plots (e.g. hero stories or stories of failure) are employed. Stories, or to use the scientific term, narratives, can be considered a common and efficient tool for conveying meaning.[3] We grow up listening to narratives such as fairy tales; we get to know typical storylines, archetypical protagonists and antagonists. As a result, narratives are easily accessible and, not without reason, culturally and religiously formative texts are usually presented in a narrative form. Central mythological and religious records (e.g. the Iliad or the Bible) convey their moral messages in narratives.[4]

Against this background, it is reasonable that journalism also uses narratives to inform audiences about scientific findings.[5] However, an understandable and convincing story also offers a way to question the outcome of scientific research and to present problematic research. In this chapter, we analyze how news stories are used to question, criticize or even argue against scientific findings. For our analysis, we use media coverage of genomic research. We have chosen this field of research for several reasons, among them its importance for society and its rapid development. Additionally, genomic research receives considerable attention in the media. Not only is it a popular and controversial topic in news media whose coverage is full of hope and fear,[6] but it is also the subject of fictional narratives in novels and films. According to Rosalynn D. Haynes, who has analyzed recurring patterns in fiction about

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science, it is especially narratives about genomic engineering that most often have recourse to stereotypes of scientists and criticisms of big business.[7] And, as we will demonstrate later, these features characterizing fiction about genetics can also be found in print coverage, which is to say, news tends to echo fiction when genomic research and its evidence is being criticized.

We first outline our theoretical framework and locate science journalism in the realm of science itself as well as journalism. In doing so, we focus on the strategies journalism usually uses to convey or even support scientific evidence. Since this chapter addresses the contrary – how coverage is used to weaken evidence – we focus our discussion on textual strategies employed to question and criticize evidence against the background of typical coverage of genomic research. Following this, we present a hermeneutic analysis of news stories, which reveals how journalism contests scientific evidence using its own (non-scientific) devices and creates counter-narratives. We focus on five linguistic and culturally contextualized strategies, which we explain in detail.

Theoretical Framework

Practices of (Science) Journalism

Publics seek to learn about scientific results to gain knowledge about technological, social and ecological developments that help to satisfy their curiosity about the future. Applications of scientific innovations (e.g. new medical treatments) may have a direct effect on their own lives. As laypersons, they usually do not have the access or expertise to inform themselves from genuine scientific sources. In this situation, journalism serves the function of mediating between science and the public and generating information that is understandable for the non-scientist.[8] Rather than merely dumbing down complex scientific content, journalists engage in a number of translations that gradually transform scientific content into a (re)construction for media presentation.[9]

In general, journalists' (re)construction of reality follows certain rules. For example, news values such as focus on conflicts, catastrophes, elites or the emphasis on human action (= personalization) can be found in almost every media report. In terms of content, news values ensure the newsworthiness of media coverage and can be considered a recurring pattern.[10] These event-related patterns are complemented by conventions concerning the form of news reports. Journalism relies on a set of well-established formats (editorials, reports, glosses, etc.) whose characteristics are clearly defined and are usually respected – at least by professional journalists. For the most part, all these journalistic norms, content- as well as form-related, determine media representations. And, as Sharon Dunwoody demonstrates for the field of science journalism, science

journalists tend to adhere to journalistic norms to a greater extent than to scientific standards.[11]

Science Journalism and Second Level Evidencing Practices

The adherence to journalistic norms is not surprising when comparing the basic systemic logics of journalism and science. Science strives for scientific validity. The function of journalism is to transform social reality in such a way that it becomes accessible to society (as media reality).[12] Therefore, social reality is transmuted into generally understandable and preferably new topics. Science journalism deals with a specific part of social reality, i.e. science. It reports on new scientific findings, including the associated evidencing processes, and may also criticize them.[13] This happens from an observational perspective because science journalists do not conduct their own studies; they do not produce scientific evidence in the narrow sense (this is mainly reserved to the science system). However, if "evidencing practices" are conceived of as the process of presenting, embedding and using evidence,[14] they also encompass textual strategies to support a claim as evident (in the realm of science), or, true and valid (in the realm of journalism).

Science journalism can describe scientific evidencing processes and, additionally, attribute evidence to certain findings linguistically, e.g. by emphasizing the quality of a study, the accuracy of its findings or its importance for further research. In a similar vein, science journalism can question the adequacy of evidencing processes or even allege fraud, e.g. by ascribing negative attributes to certain studies and methods or by using rhetorical strategies to discredit them. As a result, evidence deriving from science is either underlined or undermined by journalistic means. Thus, on an initial level, evidencing practices are located in science itself. But on a second level, journalism steps in and affirms or disconfirms evidence – resulting in what we call "second level evidencing practices" or "second level evidencing critiques". These textual strategies should not be underestimated regarding their potential influence on public opinion and the repercussions on the science system. They can either support public knowledge and acceptance of scientific research,[15] or they can destabilize science by undermining faith in scientific research. There are quite a few historical examples where (critical) media discourse and public contestations of scientific evidence have affected public support for certain scientific fields – which can even result in restrictions on research.[16] The repertoire of textual second level evidencing or critiquing practices is large, as our analysis will show, and does not necessarily focus on scientific evidencing practices. News stories give context to scientific findings and evidencing procedures; they place research in a certain setting (which can be depicted as adequate or dubious), create characters (who can be described as moral, or untrustworthy and

even evil) and, in sum, often convey a moral message.[17] As a result, journalistic critiquing practices in particular can focus on these contextual factors and simultaneously sow doubt about a scientific finding and evidencing processes.

Evidencing Practices in Media Coverage

In order to support a claim as true or valid, journalism has developed its own ways of substantiating scientific knowledge,[18] which range from science-affiliated to journalism-savvy. Susanne Kinnebrock, Helena Bilandzic and Magdalena Klingler distinguish three textual strategies to underline the evidence of a finding.[19] First, the *data and methods* of a study can be presented in news reports to justify the study's conclusions – which ultimately mirrors "evidencing practices"[20] common in the epistemic culture of science and less typical of journalism.[21] Second, experts, institutions or journals as renowned *authorities* in their specific research fields can be quoted.[22] This evidencing practice is not only applied in scientific writing; quoting authorities as sources of information is also at the heart of news reporting. Quoting authorities and, in doing so, specifying their professional roles, affiliations and positions within institutions are well-established journalistic routines to underline the quality of a source and thereby the factuality of the information. As a result, references to authorities are equally common in the epistemic cultures of science and journalism. And third, evidence claims can be supported by telling a convincing story or *narrative* (e.g. of a successful healing process).

Narratives are defined as a representation of events and characters.[23] Narratives are an everyday, natural mode of communication, widely used in science journalism because they turn scientific findings into equally understandable and tangible stories.[24] At the same time, (science) journalists can build on existing stories – on eternal stories or myths, as Jack Lule puts it[25] – to build on the audience's prior knowledge. A brief reference to mythological stories like the tragic fall of Icarus or Victor Frankenstein's incapability to control his creature can guide the reader's interpretation of a current science story and its presumed end.[26] As a result, the use of narratives can trigger different responses among the audience. Narratives can help to understand scientific evidencing procedures and thus strengthen the reader's belief in scientific evidence claims. However, narratives can also distract the audience's attention from the actual scientific point by emphasizing human interest. And additionally, a moral message is often conveyed, especially when news stories refer to myths.[27]

These three typical journalistic evidencing practices (data and methods, authorities, narratives) also provide starting points for the analysis of evidence criticism in news media. The validity of data as well as measurement reliability can be doubted, authorities can be questioned or

even be unmasked as charlatans and, most of all, narratives can be used to refute the results of a study as a whole by providing counterexamples.

Coverage of Genomic Research

As with science coverage in general,[28] coverage of genomics has increased over time.[29] In the early 1990s – with Dolly, the cloned sheep, and genetically modified food – genomic research received a lot of media attention. Topics like the human genome project, human stem cells and emerging fields such as synthetic biology or xenotransplantation were frequently covered.[30] Early studies showed that coverage of the emerging field of genomics was usually more positive than negative.[31] Genetic engineering in agriculture, however, can be regarded as an exception because news reports about this topic were more critical than news reports about genomics in general.[32] In sum, the contextualization of "green" genetic engineering and "red" genetic technologies differs. Genetic engineering in agriculture is more often covered using a risk frame, genetic treatments in the field of medicine, however, tend to be reported using a progress frame.[33] Even if media debates on genomic research are quite specific to national contexts, genomics has become an internationally relevant topic in science coverage, comprising heterogeneous evaluations,[34] which makes media coverage of genomics suitable for an analysis of second level evidence critique.

Strategies of Evidence Criticism in Science Journalism

As already outlined, the daily business of science journalists is reporting, not research. Therefore, they cannot reasonably be expected to provide scientific counter-evidence. They can, however, create critical news stories. It is up to science journalists to craft their reports, i.e. they enjoy a great deal of freedom in choosing their topics and sources, which consequently affects the conclusions to be drawn from their reports.[35] To question the evidence of a specific finding, journalists can (1) rely on the description of other, alternative or "better" *data and methods*, (2) question the credibility of *authorities* and, instead, quote other, alternative or "better" experts and (3) tell compelling (human-interest) *stories* about the "victims" of science or "failed" research.

In our analysis, we show that challenging the credibility of authorities is a common pattern of evidence criticism in journalism; the strategies used for this are *personalization* and *negative stereotyping* – strategies that resonate with fictional accounts of science and genetics.[36] For lay audiences, especially criticism that focuses on scientists as people, on their actions and their morality (= personalization) is easier to understand than lengthy explanations as to why certain data and methods are problematic. As a result, our analysis pays attention to those depicted as

dubious charlatans or mad scientists in conflict with groups of honorable scientists or even society as a whole.

It is not only characters that can be criticized. Critiques can also emerge from the plot of a story. *Conflict* is an essential feature of many plots.[37] Thus, a focus on various conflicts within an article (e.g. among researchers or between researchers and civil society) can serve to call scientific findings into question. Additionally, a narrative within an article can convey a moral message since evaluations also are vital features of narratives.[38] Including cues for a bad ending can be a strategy for questioning an area of research and its evidence in general. More generally, *narrativization* can be used in various ways to indirectly criticize science and question evidence.

Despite many language conventions in daily reporting for appropriate wording, journalists enjoy remarkable freedom in choosing their very own words to describe a particular situation or scientific result. Language can underline and deepen certain stereotypes and conflicts. And the particular choice of words can either create a narrative world or deconstruct it. At the same time, language is very domain-specific: Human interest topics, for example, are usually described with other, more emotive words than economic news. And, in science coverage, plain, prosaic language is predominant, which serves to convey the rationality of the field.[39] If wording typical of other domains (e.g. human interest, religion, esotericism) is used for science coverage, readers may build mental associations between the non-scientific domain with the research presented. The use of the incongruous language can also be a strategy to elicit doubts about the correctness of the presented scientific conclusions.

This brief overview of key journalistic strategies for criticizing science and questioning the evidence for scientific findings leads us to our research questions:

1 What types of personalization, negative stereotyping and conflict depictions can be identified in articles on genomic research?
2 What references to archetypical narratives are made and what kind of moral messages are suggested?
3 And what language and wording is used that is not common in the domain of science?
4 How are these textual strategies applied in the coverage of genomic research?

Evidencing Practices in Media Coverage of Genomic Research

The following hermeneutic analysis is part of a larger project that analyzes evidencing practices in reports on genomic research.[40] The sample of the content analysis consisted of 1,023 articles on genomic research

published by German print media and included national quality newspapers (*Frankfurter Allgemeine Zeitung*, *Süddeutsche Zeitung*, *TAZ*), regional newspapers (*Hamburger Abendblatt*, *Nürnberger Nachrichten*, *Mitteldeutsche Zeitung*), tabloids (*Bild*, *Express*, *Berliner Kurier*) as well as weekly news magazines (*Der Spiegel*, *Die Zeit*, *Focus*). A random sample with representative layers for each medium and each year was compiled and articles from the year 2000 to 2018 were included. As the main focus of this study was to investigate evidencing practices, only articles that contained a scientific finding were included.

To briefly summarize the most prominent result, one of our main insights was that scientific findings are usually evidenced by more than one journalistic evidencing practice. Explanations of data and methods, references to authorities and finally narrative elements are often used together to underline the validity of a scientific finding. Additionally, these three practices are usually used to support, not to question, the evidence of the findings. Notably, counter-narratives are rare: Among the 1,023 articles analyzed, roughly half (n = 447) the articles used narratives to illustrate the evidence of a finding. However, among these 447 articles, only 27 used a narrative to question and criticize scientific findings, which is less than three percent of all analyzed articles (or six percent of articles applying narrative elements). Consequently, the vast majority of narratives presents findings and evidencing processes in a neutral or supportive way. Focusing on second level evidencing critique, these 27 articles containing narratives that argue against scientific evidencing practices represent the basis of the present hermeneutic analysis. Given the sampling strategy of the content analysis, the compilation of the resulting 27 articles is systematic and different from selection procedures typically used in case studies. Nevertheless, some cases (like Monsanto) show up in our material because their practices are repeatedly questioned in counter-narratives. As our hermeneutic analysis will show, textual evidencing critique might be a comparatively rare, but, when used, strong rhetorical strategy in science journalism. As soon as a counter-narrative is employed to question scientific evidence, the possible textual strategies are used intensively, as our analysis demonstrates.

In-Depth Analysis of Narrative Strategies to Question Evidence and Criticize Science

Personalization

Research on personalization has a long tradition in the field of communication. It can be defined as an editing process transforming social reality into media reality by condensing complex (research) processes into a few actions and decisions by a single person.[41] A character, mostly a scientist, and his or her experiences, motives and emotions

are vividly described, which allows for a better understanding of the protagonist's point of view. Our analysis showed the dominance of two characters that are repeatedly depicted in the counter-narratives on genomic research: The mad scientist and the ruthless company. Although a company cannot be directly equated with a person, it can be depicted as a unit that acts and that has intentions and both can be judged for their morality.

In the articles analyzed, it is especially companies dealing with genetic sequencing or genetically modified plants that are criticized. These companies appear to act like human beings – and they are endowed with human attributes. According to many articles, the companies concerned seek to gain financially from the new findings – no matter the costs and consequences. Greed drives them, and Monsanto in particular is described as a ruthless, corrupt and manipulative liar. The news magazine *Der Spiegel*, for example, states with reference to Monsanto: "A global industry is trying everything to make the world dependent on genetically modified plants",[42] and the quality newspaper *Süddeutsche Zeitung* summarizes simply: "Monsanto is evil".[43]

It is no surprise that ruthless companies and mad scientists dominate counter-narratives. In their role as protagonists, they act, they fight and they have dubious intentions – which makes it easy for journalists to create a highly personalized depiction. In general, active perpetrators are more suitable characters for highly narrative news stories than passive victims. However, in some cases, the victims' stories are also told: Apart from farmers harmed by genetically modified plants, animals, especially cloned animals, are victims. They are exploited as laboratory animals, suffer and die early. One example is Dolly, the cloned sheep. Like Monsanto, Dolly is not a person. The description of her fate in the newspaper *Hamburger Abendblatt* is nevertheless touching, especially if the reader takes the perspective of a human being and makes the common idea of "a good life" the yardstick for judging Dolly's life: "Dolly lived a mere 6 years …, never knew what the sun looked like and never tasted grass. For security reasons, the cloned sheep lived in a heavily guarded concrete block, where she munched pills containing concentrated food".[44]

Stereotyping

Personalization can be regarded as a precondition for stereotyping, which we discuss with regard to the character type of the mad scientist. The importance and ambivalence of stereotypes in media coverage – as helpful organizing structures that reduce complexity as well as bundles of attributes that might be used to discriminate against particular groups of people – was already outlined a century ago by Walter Lippman in *Public Opinion*.[45] Nevertheless, content analyses dedicated to stereotypes of

scientists in media coverage are rare. With reference to fiction, Matthew C. Nisbet and Anthony Dudo identify four characters: (1) The sinister, mad scientist; (2) The powerless pawn; (3) The anti-social geek; and (4) The action hero.[46] Rosalynn D. Haynes added two more characters: (5) The stupid virtuoso and (6) The scientist as idealist.[47] While negative character depictions were prevalent in the past, Haynes points out that depictions of the mad scientist are becoming less common – at least in the realm of fiction.[48] Likewise, Dudo et al. conclude that scientists are "cast in good or mixed roles, rather than as the 'evil scientist'".[49]

Regarding the 27 articles in our sample, one negative stereotype is dominant, namely that of the *mad scientist*.[50] However, media coverage on genomics characterizes the mad scientist type as less sinister but more obsessed with scientific work. The scientist appears as a maniac impervious to moderating influences. One example is the characterization of George Church, known for his work on genomic sequencing:

> George Church, molecular geneticist at Harvard University […] is known as someone who considers very few ideas too crazy to try out himself. He and a few of his coworkers have been trying for some years to revive the mammoth […] to what end? Is de-extinction just one of those researchers running wild ideas? Stuart Pimm is even more explicit: 'De-Extinction is nothing but a way for people who otherwise have no clue about how to solve the problems of the world to get attention'.[51]

Madness combined with craving for attention is quite often attributed to scientists. And in the quotation above from the quality newspaper *Süddeutsche Zeitung*, another pattern of criticism becomes obvious: In conveying criticism or negative stereotyping, another scientist is quoted, which allows journalists to hide their views behind quotes and to keep the appearance of journalistic objectivity.

The stereotype of the mad scientist has many facets, and it is frequently gendered.[52] In our sample, an obviously gendered sub-stereotype of the mad scientist is the image of the *grumpy old man* who is unteachable and stubborn. An example is Len Hayflick, known for criticizing anti-aging medicine. The way his looks and mode of expression are described characterizes him as a grumpy old man:

> Len Hayflick's tone becomes ominous. He turns all the energy that he would like to expend stamping his feet into a low rumble. He was, in fact, only asked whether he could help non-geneticists to prolong people's lives. 'Genes have absolutely nothing to do with aging,' barks the grand old man of aging research. And his eyebrows are so bushy that they briefly protrude from behind the thick rims of his large glasses.[53]

In stark contrast to these grumpy old men, who decorate quite a few articles critical of genomic research, is a young female scientist who extended the life of threadworms genetically.

> The young woman breeds worms. Tiny roundworms [...] that wriggle harmlessly in the test tube but look like monsters with huge gullets when you look at them under a microscope. 'I like this face', gushes the researcher, showing a close-up of one of her protégés: 'Isn't it lovely?'[54]

This example from *Süddeutsche Zeitung* (like quite a few others) indicates that enthusiasm paired with detachment from common points of view seems to be particularly typical of female researchers. While the sub-stereotype of the grumpy old man appears to be reserved for male scientists, the sub-stereotype of the *unworldly enthusiast* is mainly applied to female scientists. This is not surprising as unworldliness is also part of the traditional female stereotype[55] as well as of scientist stereotypes in general.[56]

Another sub-stereotype of the mad scientist is the *angry brawler*. The weekly newspaper *Die Zeit* presents Craig Venter, a competitor in the Human Genome Project, as an "evil and angry underdog of the gene scene".[57] Competition between different scientific projects is reduced to negative emotions and quarrelsomeness as characteristic of the scientists involved. To underline how angry these competitors are, emotive expressions are used. According to conventions of journalistic writing, quotations are usually introduced with neutral formulations such as "researcher x says" or "researcher y comments". But especially in the context of the Human Genome Project, the scientists "rant", "mock", "boast", "scoff" and "badmouth".[58] *Die Zeit* concludes:

> In short, the matadors of the gene scene are boiling – partly their soup, partly with rage. 'There's too much vanity involved,' says Friedrich von Bohlen, head of the Heidelberg-based bioinformatics company Lion Bioscience. 'Prima donnas of the worst kind' are at work there. But if you take a closer look, you'll see that there's a bit more to the wrangling than hypertrophied egos. It's about merit, but also about business and, in the end, even about science.[59]

In this quotation, another facet of the mad scientist is mentioned: The mad scientist can be quite a *peacock*. Hubris and vanity are typical of the peacock sub-stereotype of the mad scientist. These attributes are often used in counter-narratives about genomic research and are usually applied to male scientists, not female ones. It is remarkable that the peacocks are unmasked in the articles – usually by colleagues who are presented as honest scientists and reflective thinkers. The strategy

behind this negative stereotyping is to depict a person in a poor light and hence to question his (rarely her) findings. Thus, it is a roundabout, but nevertheless an effective strategy for criticizing evidence. Since we do not trust braggarts or villains in our daily lives, there are few reasons to trust the findings of a peacock scientist.

The stereotype of the mad scientist deriving from fiction often includes characteristics like sinisterness and power-hunger.[60] Within our sample, however, the role of the sinister villain was not assigned to scientists. Instead, it was exclusively reserved for companies in the field of genomics. According to the counter-narratives on genomics we analyzed, the most obvious villain is Monsanto, which is described as a ruthless and greedy company:

> The peoples of the world rarely agree. But when they look at this company, everyone yells: Monsanto is evil. [...] The new group has control over what humanity eats and what penetrates the earth. It is this power that scares many people. They feel that power is in the wrong hands with Monsanto. The rise of the group was rapid. And as with almost every rapid ascent, there have been sacrificial lambs and skeletons in the closet.[61]

After this introduction, the article from the *Süddeutsche Zeitung* relates the history of Monsanto, focusing on the trail of devastation the company has left. Among other things, the article mentions pollution in the US village of Monsanto, where the company was founded, the production of glyphosate and how cancer cases were ignored, Monsanto's rise to a monopolist that blocks competitors and dictates prices, the production of the herbicide Agent Orange during the Vietnam War and finally Monsanto's sinister lobbying practices at institutions of the EU in Brussels. The article clearly suggests only one conclusion: Monsanto is wicked to the core.

Excursus Normative and Cultural Foundations of Negative Stereotyping

It is remarkable that deeply negative moral attributes are used to characterize scientists and companies in the field of genomic research. As mentioned before, less than three percent of all articles in a representative sample used a narrative to question or criticize the evidence of a scientific finding. It seems that, in general, criticizing evidence with a narrative rarely happens in media coverage of genomic research. In the few cases in which an article presents criticism incorporated in a story, however, very rich stories have been created. That means, for example, that the characters were given clear attributes, and the events were clearly evaluated. Both is surprising when considering that, thanks to the ideal of objectivity, (science) journalism usually tends to avoid too much

attribution and evaluation.[62] The intensity of the attribution results from the fact that highly moralizing attributes are used in the description (and stereotyping) of scientists. Many of these negative attributes are deeply rooted in Christian culture, especially when they refer to the seven deadly sins (sloth, lust, anger, pride, envy, gluttony and greed). Stanford Lyman has analyzed these sins as moral laws, which were historically used in many cultures (not only the Christian) to describe the evil and still affect societies all over the world.[63] Similar to myths or the holy books (be it the Bible, the Koran, the Torah or similar sacred texts), the seven deadly sins can be used to quickly classify behavior, or more precisely, to brand it as evil. Given the fact that journalism has to be understood by and resonate with lay audiences, it is not surprising that a common and unambiguous reference system based on the seven deadly sins is used to mark science and scientists as evil – which is, of course, a very harsh criticism.

The seven deadly sins and some of the negative attributes conferred to scientists in the articles analyzed coincide to a remarkable extent. The stereotypical mad scientist is a glutton for (scientific) work, but at the same time indifferent to real life and social concerns. Hence, lack of moderation as well as unworldliness is associated with *gluttony*.[64] Consequently, the love for roundworms can be read as both unworldliness and indifference to real life, which are linked to *gluttony*. The stereotypical grumpy old man shows *anger*. Angry brawlers are not only angry, but they are also envious, whereby *envy* as a deadly sin also encompasses jealousy and malevolence.[65] A peacock is full of *pride and vainglory*. And, finally, the ruthless company is definitely characterized by *greed*. Without overusing the seven deadly sins, a very important pattern of criticizing scientists and thereby science and scientific evidence has become obvious: Coverage of genomic research points toward the moral deficits of some scientists and companies. Stereotyping takes place along a dimension of deeply moral attribution.

Conflict

The counter-narratives we analyzed were full of conflicts. And the pattern just described for stereotyping – the reference to deeply moral categories – also becomes visible when we consider the whole story rather than a single character. The articles often tell the story of a fight between good and evil. The lines of conflict primarily lie between the evil and money-grubbing genetic engineering companies and their opponents, who are mostly honest organic farmers, eco-activists or upright, research-oriented scientists. Additionally, conflicts arise between scientists themselves. Good and reflective scientists, who respect the limits of what is ethical or feasible, struggle with mad scientists who do not care about limits and consequences.

The conflicts are underlined by two rhetorical strategies: Scandalizing and ridiculing. Scandalizing is a well-known strategy in journalism. The roles (victim or perpetrator) are clearly assigned. The perpetrator is publicly accused of violating a norm, the event is explicitly called a scandal and indignation is articulated.[66] Since trust in a scandalized perpetrator is compromised, scandalizing scientists can be used as a strategy apparently to question the researcher as a person, but actually denigrating their research and evidencing practices. Scandalizing, therefore, can be regarded as a subtle or indirect form of evidence critique.

Another way of sowing doubts about science and evidence is ridiculing scientists, their findings or even a whole research field. Some counter-narratives in the articles analyzed were full of irony and mockery. Genetic sequencing and its results are described by the weekly newspaper *Die Zeit* in the following way:

> Genome experts want only to assign about 35,000 genes to humans. And once again, this stirs controversy. Although everyone was tremendously excited about it, the outcome is somewhat unwelcome. Some bemoan the third narcissistic affront to humankind by science. First we were downgraded to a product of evolution along with monkeys and lice (Darwin did not dare claim this, but it is nevertheless the case), then we were declared to be the oppressed of the subconscious (Freud did in fact claim this, but it is nonsense), and now this: A threadworm of just 959 cells manages to have 19,098 genes, and humans with their 100 trillion cells have only a third more.[67]

Myths and Master Plots

Master plots contain an evaluative and moral dimension that frame media coverage and guide its interpretation.[68] The counter-narratives investigated in this analysis feature a master plot of failure. On a micro-level, single events of failure – a failed experiment, a big error or the death of a cloned creature – are widely reported. On a macro-level, the master plot and the evaluation of the narrative suggest the futility of the endeavor or the inevitably bad ending. For example, the stories emphasize that nature will revenge itself for human interventions, hubris will be punished and interference with the divine order will lead to disaster. To underline these messages, explicit references are made to well-known myths such as the Frankenstein myth, which stands for a monstrous creation as a consequence of a scientist's arrogance and hubris in seeking to be the creator of life.[69]

In sum, the failure master plot either emphasizes that the scientists fail to produce evidence, or it frames the whole research enterprise as extremely negative. As a result, the articles cast doubt on the evidence

of the research presented. And the recurring moral message is "Keep the end in mind!" – which is both the headline from the newspaper *Frankfurter Allgemeine Zeitung* and a biblical phrase.[70] The reference to the divine order leads to the last of the five strategies of science criticism. The use of language that is typical of another domain – for example, religion or esotericism.

Language

Just as the name Frankenstein evokes ideas of the myth associated with it, words from domains other than science can be used to associate science with fields that, at first sight, do not have much in common with science and its evidencing practices. In the counter-narratives we analyzed, we were confronted with many words coming from the fields of fortune telling ("oracle", "crystal ball", "fortune teller"), magic ("wizard", "magic words"), science fiction ("chimeras", "mixed creatures") and dubious quackery ("promises of healing", "truth serum", "wishful thinking"). And it is remarkable that these words are not only used occasionally; they pervade our analyzed counter-narratives. They suggest that the respective article deals with an esoteric or fictional plot, not with science. And this strategy, placing genomic research and its evidencing practices in completely science-free domains, can be regarded as an attempt to cast doubt on the correctness of the presented scientific findings and conclusions.

In the same manner, references to religious language and biblical sayings are used and create religious allusions: "Their magic word is stem cells. Whoever can breed and train these all-healing cells like the shepherd trains his dogs, the lame and sick will make a pilgrimage to the Holy Land like the pious used to do".[71] Sentences like this, which seem strange when readers are expecting solid journalistic prose, re-emerge frequently. Biblical expressions are also used extensively. Scientists are referred to as "creator" or even "god"; "satan" or the "devil" comes into play and leads to "temptation"; scientific communities are called "parish" or "gene church"; scientific controversies "wars of faith" and scientific findings "promises of god". These are only a few examples which give the impression that religious phenomena are being described in the articles, not science and its evidencing practices.

Finally, antiquated language (*"zum gleichen Behufe" – for the same purpose*, *"Ein Tor, wer glaubt" – a fool who thinks that)* is occasionally used, suggesting time travel to pre-modern, even medieval times, in which theology rather than science was the dominant knowledge system and the natural sciences were associated with alchemy and the production of gold.[72] The extensive use of words and phrases untypical of journalistic writing is not coincidental. Rather, the use of a language that is not appropriate for covering science can be regarded

as a strategy to achieve an image transfer from irrational, ideological domains to the field of science. And as soon as science is associated with such domains, doubts about its findings, conclusions and evidencing practices are easily sown.

Conclusion

We have presented counter-narratives that question and criticize the scientific findings and evidencing practices in the news coverage of genomic research. In all, these counter-narratives are rare; the vast majority of narratives function to support the evidence of findings in genomic research. This might not be surprising since our quantitative content analysis focused on articles containing an empirical finding from a study. When science and its core activity – carrying out studies and producing evidence – are reported, it might be easier for journalists to construct narrative descriptions of studies than argue against study results and their evidence. In the rare case that a narrative is used to undermine research, the criticism is usually indirect in the sense that it is not the finding as such that is criticized or questioned, but the moral integrity of the scientists and companies involved. The criticism is quite sharp and attuned to the readers' everyday experience and life: Counter-narratives are stories about evil villains, mad scientists and failure.

Patterns of prototypical counter-narratives emerge and they have a striking resemblance to archetypal myths – notably in a format (science journalism) that is dedicated to conveying hard scientific facts to a wider audience. A prototypical counter-narrative follows common steps that – in an evil master's handbook of counter-narratives – might read like this:

a Identify the perpetrators! (personalization)
b Describe their bad character! (negative stereotyping and its moral foundation)
c Evoke the conflict between the good and the evil! (conflict)
d Refer to archetypical narratives and suggest that the story will end badly! (master plots)
e Use language from other well-known mystic domains to make research and its evidencing practices appear in a dubious and irrational light! (language)

At first sight, the elements of these archetypical science stories on genomic research might have little to do with scientific evidencing processes because of their non-scientific focus on the (bad) character of researchers, on recurring human conflicts or stylistic devices like language. However, these narrative elements can be used as strategies of critique. They create the context in which research and evidencing

practices are depicted and therefore can affect lay audience's perceptions. It has to be remembered that, outside the science system, first level evidence practices are mainly perceived through the lens of second level evidencing practices – and among these are narratives.

The emphasis on morality reveals the basic function of counter-narratives – to warn against potential dangers and interests of actors that are located outside of science itself. Notably, such discourse, borrowed from well-known myths and master plots, is much more intelligible and familiar to a non-scientific audience than the scientific facts themselves. Whether this serves to make audience judgments more nuanced and critical, or to shift the focus away from public engagement with science to a generalized distrust toward science due to more or less fuzzy moral concerns, must be the subject of future research.

Notes

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