Article

Science blogging: an exploratory study of motives, styles, and audience reactions

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ABSTRACT: *This paper presents results from three studies on science blogging, the use of blogs for science communication. A survey addresses the views and motives of science bloggers, a first content analysis examines material published in science blogging platforms, while a second content analysis looks at reader responses to controversial issues covered in science blogs. Bloggers determine to a considerable degree which communicative function their blog can realize and how accessible it will be to non-experts Frequently readers are interested in adding their views to a post, a form of involvement which is in turn welcomed by the majority of bloggers.*

Context

Digital forms of communication play an increasingly significant role in discussions about the future of academic discourse — both with stakeholders outside of science, but also among scientists [1, 2]. The phenomenon of science blogging — maintaining a web log to present and discuss findings from academic research — is one example of such new practices that has attracted attention in recent years [3–6]. Specialized platforms (e.g., Nature Network, scienceblogs.com, hypotheses.org), but also universities and research institutes offer blog hubs for academic content, while other bloggers rely on commercial hosting platforms such as wordpress.com and blogger.com.

Blogs can be used for different kinds of exchange around scientific information. In some cases, science blogs have triggered relevant academic discussions among experts [7]. A prominent example is the controversy concerning an article in the journal *Science* regarding the potential of a type of bacteria to process arsenic instead of phosphorus to sustain itself [8]. The article was pre-released online in December 2010 and immediately received massive criticism in blogs, most notably by Rosemary J. Redfield [9], a microbiologist at the University of British Columbia. Through her blog and those of colleagues, a group of scientists began exchanging and collecting criticism of the original study. This contributed to eight 'Technical Comments' that appeared alongside the original article in the printed issue of *Science* in June, 2011, and two papers that replicate the original study but come to different conclusions, published in *Science* in July, 2012.

Blogs and traditional forms of scientific communication can thus be fruitfully combined to advance scientific discussion. But this is only one side of science blogging, and arguably not the most prominent. On the one hand, the majority of scientists remain extremely skeptical of blogs, both as a tool for discussion and as a new avenue of publication [10–14]. On the other hand, blogs usually have interactive features that allow for much more direct and spontaneous exchange between authors and readers than in many other forms of science communication. And they are mostly publicly visible, carrying the potential to reach a much wider audience than traditional scientific outlets. This has led to optimistic views on science blogs as a new platform for mediating science and research [15, 16].

But studies have also expressed doubt about the impact that science blogs can have, beyond a few highly publicized cases. Analyses beyond such single events or blogs are largely missing. And it is unclear how different types of science blogs (e.g., written in a style similar to traditional scientific publications vs. aiming at mediating science to laypersons) are used, both by their authors and their readers. In this paper, we explore the motives, style, and impact of science bloggers by means of a survey and two content analyses. We focus on science blogging as a means of communicating the findings of scientific research to a broader audience, thus leaving out other uses of blogs in academic contexts that focus on, for instance, teaching or informal exchanges.

Science blogging and bloggers

The term science blogging is most often used to describe the use of blogs dedicated to research-related content of some sort, written by a person depicted as a subject-matter expert on the blog website. As a consequence of the openness of the format, there exists no single definition of what constitutes a science blog, mainly because neither who passes as an academic expert nor what qualifies as scholarly content can be described with perfect accuracy [7]. A common theme in the literature on science blogging is a gradual shift from the role of blogs as tools for casual writing and knowledge management to instruments for spreading information and conducting self-promotion, a change that often goes hand in hand with the academic progression from PhD student to more experienced scholar [17–19]. This implicitly defines the prototypical 'subject-matter expert' authoring a blog as a member of a university or research institution. But teachers, undergraduates, or journalists can also be considered authors of a science blog [4]. Defining science blogs by the academic credentials or institutional affiliation of their authors is further complicated by the fact that not all blogs on science and research provide such information or that this information can be hard to verify.

Content-driven studies approach science blogging less from the perspective of actors and more from the vantage point of information, text, and genre [4, 20, 21], underscoring bloggers' interest in distributing content and sparking discussion (rather than experimenting with new ideas). Wilkins assigns blogs the role of a mediating instrument between academia and the general public:

> Blogging is also a way to demythologize science. Unlike laws and sausages, the public should see science during its manufacture, but the lay public is generally ill-equipped to interpret what they see, and science bloggers play a crucial role here [22, p. 411].

Wilkins thus sees blogs as a modern means of conducting science communication with the broad public. The overarching aim of such an approach is to use blogs and other social media to further a 'democratization of science.' However, Kouper's content analysis of eleven science blogs shows that frequently the claim of addressing a lay audience is not redeemed by science bloggers [15]. Both the choice of topics and the linguistic presentation of the material are rarely suitable to complete laypersons and science blogs appear often to be mainly read by academic researchers or by people with a decided interest in academic information. Kouper thus concludes that science blogs appear to serve a function comparable to a 'virtual water cooler' [15] around which experts share and debate context-specific information in a more or less informal manner. This seems hardly compatible with the goal of 'democratizing' science and research [23]. Yet for many bloggers, presenting the results of scientific research to the public is of at least some significance [24].

Kjellberg's survey of blogging academics highlights the complementary function of blogs for the distribution of content and personal knowledge management [25]. According to her respondents, an important feature of blogs is that they allow publishing spontaneously and without rigorous stylistic and formal constraints and the requirements of editors and publishers. Bloggers carefully consider their audience and make stylistic and thematic choices according to the assumed makeup of their readership [16, 26]. But as it is never truly possible to know who is among the audience, a degree of uncertainty remains about the appropriateness of these choices.

The form and function of a science blog is also influenced by its design and presentation [16, 27]. The meta-platform researchbloging.org, for instance, aggregates blog posts that discuss peer-reviewed research articles with a clear emphasis on life and natural sciences [28]. The French platform hypotheses.org, on the other hand, hosts over 400 *cahiers de recherche* (research notebooks) which are supposed to open up the workplace of researchers, mainly from the humanities, to a wider public. Here, it is not the research that is scrutinized by peers, but the blogs themselves which undergo a formal review process before being admitted to the platform.

Science blogs and their audiences

Compared to the research on characteristics of science blogs, their authors, and *intended* audience, studies of actual science blog readers are even rarer. Given the tentative estimation that Trench provides, science blogs account for only a small fraction of the entire blogosphere [7]. It comes as no surprise that figures on the readers of such platforms are largely missing. Batts et al. report that some science blogs can be considered to rank among the so-called A-list, with a million visits or more per month [3]. But usage of

blogs in general differs considerably between countries and segments of a given population [29, 30], and how this usage is divided across different topics (e.g., politics, science, fashion, or sports) is unknown.

Exploratory studies suggest that science bloggers are also avid blog readers and make up a considerable proportion of the audience of science blogs, which likens them more to forms of internal communication within the academy [31, 32]. A non-representative survey of Chinese blog readers provides at least tentative indicators for the frequency of science blog usage [33]: science and education attract a medium level of interest, markedly below the level of interest for entertainment. While it seems that the role of science blogs as a bridge between academia and the public is currently marginal, cases such as that of Rosie Redfield point towards the possibility that science blogs may target and successfully reach science journalists and other expert multipliers, rather than genuine lay audiences.

A central motive of reading blogs in general is seeking information which can be conveniently accessed [34, 35]. The only study on *science* blog readers so far seems to be by Littek, who conducted a survey among the audience of two German-language science blogging platforms [36]. Readers were found to appreciate science blogs as an informative, but also informal and sometimes entertaining format, depending on their own background. The diverging viewpoints about the strengths and weaknesses of blogs among different groups of readers have implications for the approaches of bloggers, who are faced with the choice of either following the demands of non-expert readers for clarity and simplicity, or write in a fashion more akin to the scholarly genre with which they are already familiar.

Objective

The findings on how bloggers, but also readers use science blogs reveal a plethora of approaches and expectations toward blogging, among both groups. Among other things, science blogs can be spaces of personal expression, for instance in PhD blogs where authors may address their personal experiences and hardships, or they can be mainly channels of self-promotion. When the interactive potential of blogs is brought to the forefront, they can act as platforms of scientific discussion among peers or as fora of debate with the wider public. While the current diversity of approaches is unlikely to change in the future given how strongly a blogger can shape his or her own blog in terms of style and content, the motives of bloggers may clash with the expectations of readers in undesirable ways.

Science blogging could advance the 'democratization of science' [37, 38], yet as outlined above, not all approaches to blogging are equally qualified in this regard. In the following, we first analyze the expectations of science bloggers in interacting with different types of audience members (Study 1). We have surveyed contributors to a German platform for science blogs about their intentions, practices of blogging, and experiences with reader interaction to study bloggers' intent. We then look at how blogs and individual blog posts are actually received (Study 2) as well as how specific characteristics

determine reactions to a blog or post (Study 3). We assume that bloggers' intent and users' reactions may be codependent: if a blogger chooses, for instance, to write in an academic style, this may exclude readers not familiar with the terminology. The blog then functions primarily as a 'virtual water cooler' or 'virtual ivory tower,' rather than a bridge to the general public.

With regard to audience reactions to science blogs, we traced these two competing conceptualizations by coding for the linguistic properties of both blog posts and reader comments, assuming a stylistic correlation of the two. In order to gauge a wide variety of uses of blogs by their respective audiences, a first content analysis examined blog posts from different platforms and compared their structural features with the amount of comments left by readers. A second one examined interactions between authors and readers via science blogs in more detail for five topical cases.

Study 1: views and motives of bloggers

In order to examine bloggers' attitudes towards their potential audiences in more detail than is currently available, we conducted a web-based survey of authors active on the German platform Scilogs in May and June 2012. Scilogs is run by commercial popular science publisher Spektrum der Wissenschaft and hosts over 60 blogs in total, most of which are written by a single author, representing a wide range of different academic backgrounds (university professors, graduate students, hobbyists). The vast majority of content in Scilogs is written in German and most contributors are from Germany. There are no fixed criteria for the recruitment of bloggers, though the editorial staff of Scilogs reviews applications by new contributors and expects a sufficient level of academic credentials. The participants of our study were recruited via a call from the platform management published in the site's internal newsgroup and via e-mail. Reminders were sent two weeks after the start of the survey and three days before its end. We received responses from 44 authors, providing us with a large sample of the platform's active bloggers. Bloggers answered standardized questions on their blogging intentions and history, their academic background, as well as their experiences with reader interaction. Bloggers named their intended readership and rated opinions on blogging on a gradable scale (e.g., from *strongly agree* to *strongly disagree*). The frequency of actual experiences with reader interaction was recorded from *never* to *very often*. Selected demographic variables were also obtained, but the questionnaire was carefully designed to assure anonymity.

The majority of respondents were either between 30 and 39 (30%), or 40 and 49 (30%), and a large portion of participants were male (73%). Scilogs has a marked bias towards the natural sciences (e.g., physics, chemistry, geology), with 59% of respondents reporting to be from that area. Another 20% came from the humanities, while 7% hailed from the social sciences, and 5% associated themselves with life sciences (biology, medical research), engineering, or a combination of fields. Forty-six percent hold a PhD. Sixty percent reported to have blogged for over two years and 50% write for another blog in addition to their blog on scilogs.de, most often with a focus on similar academic themes.

When asked why they started blogging about science and research, motives tended to be mixed (Table 1). A majority of bloggers enjoy writing as such (79% agree or strongly agree), want to present their discipline to the public (67%), but also like to engage in discussions with other people (61%; bloggers could indicate multiple motives). Consequently, over 80% of the bloggers intend their blog to be read more or less by anybody with an interest in the topics they cover, or the public in general. But 45% also found the idea of colleagues from their field reading their posts appealing, which may point to a dual role of blogs as channels of internal scholarly communication as well as public debate.

The bloggers' reactions to comments made by readers show that such discussions often take place. Over 80% say that readers sometimes or often leave comments because they are interested in factual exchange over a topic, 75% get asked questions at least sometimes. With regard to praise and criticism, the results are mixed. Positive feedback on the blog is quite common (77%), but 34% say they sometimes or often receive overly critical comments. And 29% report that comments solely intended to provoke the blogger or other readers happen at least from time to time. On the other hand, the blog is not a medium through which scientific collaboration is initiated (62% say this has never happened to them, for an additional 36% this is rare).

The surveyed bloggers see blogging as a strongly interactive phenomenon in the sense that they attach importance to receiving comments on their blog posts. It seems that they also enjoy at least some degree of controversy, as they appear undeterred by critical responses. The contributors are predominantly male, middle-aged, and well-educated (in addition, about two thirds have experience with teaching in higher education), which may influence the type of science blogging practiced in Scilogs. A platform with more diversity in relation to age, gender, and academic seniority could arguably produce a different style of science blogging.

Study 2: comparing the style of science blog posts

In order to survey science blogging and audience responses more broadly, we turned to manually examine all blog posts published in five well-established international science blogging platforms in a natural week (9–16 January, 2012): scienceblogs.com (English), researchblogging.org (English), hypotheses.org (French), amazings.es (Spanish), and scilogs.de (German). Together, these platforms cover a diverse set of disciplines, with scilogs.de leaning more towards the natural sciences and hypotheses.org leaning more towards the humanities. They also reflect different language communities and utilize somewhat different approaches to science blogging. Researchblogging.org, as stated above, aggregates blog posts discussing peer-reviewed research mainly from the life and natural sciences. Scienceblogs.com and scilogs.de are run by popular science publishers (National Geographic and Spektrum der Wissenschaft, respectively) and advance the ideal of conveying scientific research to laypersons. Hypotheses.org (then mainly written in French), on the other hand, hosts research notebooks kept by researchers from the social sciences and humanities who document their academic work in progress. On amazings.es

Table 1. Opinions of bloggers on blogging and blog readers

Motives for starting a blog	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I just enjoy writing.	0%	0%	21%	33%	45%
I want to present my discipline to the public.	12%	9%	12%	42%	26%
I like to engage in discussion with others.	2%	9%	28%	33%	28%
I want to answer questions and give advice.	19%	9%	33%	35%	5%
I want to present findings from my research.	37%	19%	16%	16%	12%
I want to advance my career outside of academia.	38%	19%	19%	19%	5%
I want to advance my academic career.	64%	21%	7%	7%	0%

Intended readership [a]	
The public in general	84%
People with an interest in my discipline	82%
Colleagues from my field	46%
Students from my field	43%
High school students	32%
Policy makers	14%
People from my field who could decide over my future career (e.g., with regard to job applications or grant proposals)	9%

Frequency of types of reader comments	Never	Rarely	Some-times	Very often
Readers seek factual discussion.	7%	12%	33%	49%
Readers praise me or my posts.	2%	21%	63%	14%
Readers ask direct questions.	2%	23%	55%	21%
Readers indicate (factual or putative) mistakes in my post.	11%	30%	48%	11%
Readers are overly critical.	23%	43%	25%	9%
Readers pick a fight, want to provoke others.	30%	41%	18%	11%
Readers want to collaborate with me (outside of academia).	54%	26%	21%	0%
Readers want to collaborate with me on research.	62%	36%	2%	0%

[a] Respondents could indicate multiple groups.

(since renamed naukas.com; supported by magazine publisher Quo), science and research are approached from a more skeptical, humorous, or entertaining angle.

It should be noted that since no comprehensive list of science blogs exists, our sample provides a snapshot, rather than a representative survey of all activities that could potentially be subsumed under the label science blogging. However, our selection is broader than many existing studies which typically focus on only one blog or platform [4, 20, 21, 23]. We chose to study the five selected platforms to portrait different approaches and reactions to science blogging and to include both well and less known blogs with diverse aims, foci, and readerships in our sample. However, since we manually coded each blog post, the sample size had to be limited to a number within reason. We tracked all activity on the five platforms via their RSS feeds and Twitter accounts, and their websites were manually checked for additional blog posts published during the chosen week, after which we manually saved and subsequently coded the content. The two coders were German native speakers who are fluent in English. One coder holds a degree from a French university, the other has lived and worked in Spanish speaking countries. No major external event (e.g., a natural disaster or academic scandal) became apparent over the course of the week that could have distorted our sample.

In total, 293 blog posts were published on the five platforms during the selected week. They were coded for academic discipline, linguistic complexity (1 = *low complexity*, written in everyday language, 2 = *intermediate complexity*, written in an academic style, but providing explanations or links for discipline-specific terminology, 3 = *high complexity*, written in a complex style that takes an understanding of discipline-specific terminology for granted), and type of blog post (1 = *academic commentary*, i.e., discussing research or related matters following academic standards, 2 = *free comment*, comments of a more relaxed and/or entertaining quality, 3 = *mediation of research to laypersons*, posts with a focus on explaining complex matters to non-experts, 4 = *political comment*, focusing on political aspects of academic research or practices, 5 = *posts related to the blog or platform as such*, 6 = *other*). The number of comments to a blog post was recorded one month after publication. Agreement between coders was assessed using the SPSS macro described in and provided by Hayes and Krippendorff [39]. For most categories, Krippendorff's alpha was already very high initially. For others, the coders continued training until alpha reached at least a value of .70.

Blog posts related to the platform or blog as such were excluded from the analysis of topic and complexity. About three out of five of the remaining 289 blog posts approached their topic in an everyday style, allowing readers without a discipline-specific background to understand their content (Table 2). All posts on the (more entertaining) platform amazings.es were written in everyday language, while this was true for 92% of posts on scienceblogs.com and 79% on scilogs.de. On hypotheses.org, 57% of posts were written in a colloquial style, the rest with an intermediate level of complexity. Only on researchblogging.org, posts of intermediate complexity are most frequent (57%), and a notable amount of posts with a high level of complexity was observed (12%). Posts of the latter category were most frequent in academic comments, while political and free comments

Table 2. Linguistic complexity of blog posts and number of comments by platform.

	Low	**Intermediate**	**High**	**N° of comm. M (SD)**
All platforms (289)	64%	32%	5%	9.6 (39.7)
Amazings.es (13)	100%	0%	0%	15.8 (11.3)
Hypotheses.org (49)	57%	43%	0%	1.6 (3.4)
Researchblogging.org (104)	32%	57%	12%	2.5 (5.2)
Scienceblogs.com (99)	92%	7%	1%	19.4 (65.8)
Scilogs.de (24)	79%	21%	0%	13.0 (17.0)

were predominantly written in everyday language. Interestingly, linguistic complexity varied in posts intended to explain scientific research and practices to laypersons: 57% of such posts were written in everyday language, 39% showed an intermediate level, 4% even a high level of complexity.

Linguistic complexity is related to the amount of feedback a blog post receives from readers. The more demanding it is to understand a post, the less comments can be observed (Spearman's rho = -.22, p < .001). By contrast, the number of comments is only moderately associated with the number of page impressions (for the 24 posts on Scilogs, Pearson's r = .39, p < .06; page impressions are not available for the other platforms). On average, each of the 289 science-related blog post received 9.6 comments by readers, but these were found to be very unevenly distributed. Thirty-seven percent of the posts received no comments at all within a month after publication, another 33% received between one and five comments. At the other end of the spectrum, two posts received over 100 comments (more than 400 and 800, respectively). Both stem from the blog 'Respectful Insolence' (hosted on scienceblogs.com) and deal with controversies about the benefits and risks of vaccinations.[1] Three more posts from this blog, two of which also discuss vaccination, received over 50 comments. This level of reader response was only achieved by three other posts, two from scienceblogs.com (one about media coverage of climate change and one originally about the role of the null hypothesis in research — but on which the discussion quickly diverged toward climate change) and one from scilogs.de (covering a food scandal about germs in poultry that are resistant to antibiotics). Apparently, only well-established controversies (vaccination, climate change) as well as a current food-safety scandal were able to spark a high level of participation from readers, at least in the week under study. A wider range of disciplines and topics were represented in blog posts that received between 20 and 50 comments within a month (25 posts, or 9%). These posts tended to be written in everyday language and partly covered political angles of a topic. Some of them directly asked readers for participation, for instance inviting them to nominate their word of the year, while others addressed established, but apparently less controversial or pressing issues from a variety of backgrounds (e.g., gender differences, food safety, or open vs. toll access to academic journals). Overall, a large part of the blog

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[1]On online controversies about vaccinations, see, e.g., [40, 41].

posts did not receive any comments or only a very small number, regardless of the hosting platform. Interaction between bloggers and readers only seem to occur under special circumstances: we found a high number of responses from readers to posts on current events and on blogs with a well-established and sometimes quite adversarial readership, as in the case of 'Respectful Insolence' which focuses on the controversial views associated with vaccination. Case studies of successful science blogs already exist [23], yet it is unclear what makes readers engage with such platforms beyond these apparently few exceptions. The following content analysis focuses on this question.

Study 3: five controversial blog topics and reader responses

A third case study analyzed relationships between the form and content of blog posts and the reactions from readers in more detail. We examined five controversial debates in the science blogosphere in 2010 and 2011 by conducting a more detailed content analysis of different types of blog posts on each topic, as well as reader comments. The comments are indicative of readers' interests. In addition, comments can influence the perception of content by subsequent readers [42]. As Study 2 has shown, controversies and current crises seem most prone to incite responses from readers of a science blog. All five cases in this study were covered by mainstream media, which is likely to have raised awareness for the respective issue and prompted readers to encounter a science blog in a search for more information [43]. Unlike long-established controversies, all five events are marked by a clear starting point which enabled us to define time frames in which to search for pertinent blog posts.

The controversy around bacteria and their alleged ability to process arsenic was chosen as a first prominent example. The original micro-biological study in *Science* received considerable attention in the mass media, mostly with regard to the question of whether arsenic-processing life forms could survive on Mars. A second study, published in *Science* in April 2011, that was reported on in the mass media as well, applied comparative methodology from genetics to the study of phonetic diversity and the origins of human language [44]. Like the arsenic paper, the linguistic study received a number of 'Technical Comments' by other scholars and responses by the original author in subsequent issues of *Science* and a second study expressing doubts about the findings of the original analysis.

Two additional cases relate to then current events of crisis and risk: the earthquake and tsunami in Japan in March 2011 and the resulting nuclear disaster at Fukushima, as well as an epidemic of an aggressive strand of E. coli that caused thousands of infections and over 50 fatalities in Germany in May and June 2011. Both examples present cases of acute events with potentially large risks for the safety of individuals and societies that were not immediately under control. Early official public statements and media reports could often not answer all questions raised in the aftermath of the respective event, which may have led people to search for answers or advice elsewhere, among others science blogs.

Lastly, 2011 saw a general debate in German media and society, but also in science blogs, about standards of academic practices when the doctoral thesis of the then minister

of defense was shown to be heavily plagiarized and the minister subsequently resigned from his office in early March.

On these five topics, English and German language blog posts were identified through different search engines, platforms that host science blogs, among others science-blogs.com, scilogs.de, and researchblogging.org, and by snowballing from initial results to posts referred to in blogs and comments. Posts that were found to be mainly political in nature were excluded. Both the post itself and information on the blogger had to suggest that the author had an advanced understanding of the respective disciplines and of academic conventions.

In a pretest, two trained student coders both analyzed blogs and comments that represent in amount about 10% of the final sample, but were not included in the subsequent analysis. Final reliability between coders was rather high, with Krippendorff's alpha between .70 and a maximum of .91.

In a first step, all science blog posts on the five cases identified in the search were classified with regard to discipline, type of post, and comprehensibility, using the same categories as in Study 2. The language employed in the posts was also coded for level of criticism and humor or entertainment expressed (*none*, *some*, *strong*; all combinations are possible, acerbic satire, for instance, was coded as *strong criticism* and *strong humor*). On each of the five cases, blog posts were selected that showed different combinations of the respective categories, but the number and qualities of the posts on each case varied greatly. Characteristics of the selected blog posts are reported in Table 3.

For the selected 25 blog posts, comments made by readers (and bloggers) below the original posts were analyzed. Up to 90 comments were coded per blog; if the number of comments exceeded this limit, the first 50, middle 20, and last 20 comments were selected. A total of 1,271 comments are included in the analysis. Comments were classified by linguistic complexity and the alleged reasons readers have for contributing to the comment section: adding information, expressing agreement or criticism, thanking the blogger or other readers for their contributions, asking a question, as well as providing answers or advice. This category was developed from studies on motivations for using blogs, that underline the importance of social interaction and information seeking [34, 35], and refined during the pretest to capture basic speech acts that can be coded with high reliability. Up to two reasons were coded.

Table 4 shows that differences in the way a blogger chooses to cover the respective event or publication seem to influence how readers react to the blog. Comments are mostly written in everyday language of low (scientific) complexity. If the blog post is more demanding, however, comparatively more readers also comment on a higher level of complexity. This could reflect that readers take the language of a given blog post as a model for their own comments. On the other hand, blog posts written on an advanced level of academic language could also exclude readers without the competency necessary for understanding and thus for answering to these posts in a similar way.

The type of a blog post only slightly influences why readers leave a comment. Unsurprisingly, comments are predominantly written because readers wish to contribute addi-

Table 3. Blog posts selected for the content analysis.

Blog posts	Type of post	Complexity	Criticism	Humor	N° of comm.
		Characteristics of blog posts			
Bacteria and arsenic					
We Beasties (1) [a]	Academic	High	Some	None	36
We Beasties (2) [a]	Academic	Intermediate	None	Some	9
We Beasties (3) [a]	Academic	Low	None	None	5
Not exactly rocket science	Academic	Intermediate	None	None	58
Bad astronomy	Mediation	Intermediate	None	Some	165
Pharyngula	Academic	Intermediate	Some	Some	138
Phonetic diversity					
Sprachlog (1)	Mediation	Low	Some	None	16
Dienekes	Academic	Intermediate	None	None	37
Languagelog	Academic	Intermediate	Some	None	59
Fukushima disaster					
Physikblog	Mediation	Intermediate	Some	Some	947
Prima Klima (1)	Political	Low	Strong	Strong	111
Mike the mad biologist	Political	Intermediate	Some	Some	21
Fischblog	Academic	Intermediate	Some	None	87
Relativ einfach	Academic	High	None	Some	9
Klimalounge	Academic	Intermediate	None	None	33
Kritisch gedacht	Free	Low	Strong	Some	282
Sankore	Mediation	Intermediate	None	None	7
E. coli epidemic					
Enkapsis	Academic	High	None	None	36
WeiterGen	Mediation	Intermediate	None	None	64
Prima Klima (2)	Free	Low	None	Strong	57
Erklärfix	Political	Low	Strong	None	50
Plagiarism in minister's thesis					
Frischer Wind	Mediation	Low	None	None	150
And the water seems inviting	Political	Low	Some	None	36
Sprachlog (2)	Academic	Low	Some	Some	100
Anatomisches Allerlei	Free	Intermediate	Some	Some	16

[a] The three posts on the blog 'We Beasties' were written by three different authors, one of whom is not a regular contributor to the blog.

tional information, their own thoughts, or criticism to the blog. Following an academic or political comment by a blogger, readers criticize more often, while posts that aim to explain events to laypersons receive more thankful comments. Differences between the five cases of blog topics are reported in table 5. There are a few more questions on the

Table 4. Complexity of blog posts and comments.

	Complexity of blog posts			
	Low	Intermediate	High	Total
Complexity of comments	n = 510	n = 671	n = 78	n = 1,259
Low	87%	63%	42%	71%
Intermediate	13%	30%	22%	22%
High	1%	8%	36%	7%
Total	101%	101%	100%	100%

Table 5. Reasons for commenting on five blog topics.

	Blog topic				
	Bacteria and arsenic	Phonetic diversity	Fukushima	E. coli	Plagiarism
Reasons for comments	n = 262	n = 119	n = 405	n = 200	n = 215
Adding information	56%	84%	69%	72%	73%
Expressing agreement	27%	12%	13%	13%	14%
Expressing criticism	27%	46%	33%	31%	26%
Thanking blogger/others	19%	3%	9%	8%	2%
Asking questions	11%	10%	17%	24%	20%
Giving answers/advice	8%	9%	12%	9%	7%

Note: up to two reasons were coded per comment.

three acute events, Fukushima, E. coli, and the plagiarism scandal. The two more academic topics received a slightly different pattern of comments: comments on the study on phonetic diversity received more criticism and further information, while comments on bacteria and arsenic tended to be more positive and express agreement with the blogger or fellow commentators. This may be due to the fact that the blog posts already criticized the original study on arsenic-processing bacteria in *Science* and readers agreed with this criticism (which is also reflected in the higher number of thankful comments). Linguistically, comments seemed to follow the direction of the respective blog post. For the three acute events, between 75% and 93% of comments were written in everyday language, while for the two more academic topics the complexity of the language used in comments was higher, especially for the linguistic case.

The results from Study 3 reveal that the style and content of a blog post not only impact the quantity of responses from readers as shown in Study 2, but also their quality. Science blogs can be used successfully to prompt discussions with a scholarly component in a forum where experts relay information to non-experts and engage in discussion with them. On the other hand, a science blog can also, willingly or by accident, become a platform for academic exchange which largely excludes laypersons. In this study, such a scenario was observed especially on the less acute and more academic cases, based on recent publications in *Science* magazine. Thus, it is very much up to the blogger to create the setting in which interaction and mediation of academic content can take place.

Conclusions

Our study has analyzed relationships between the attitudes of science bloggers, the style, and content of blog posts, and the responses of readers. While not representative, our results cover a broad picture of scientific blog usage. They show that intentions of bloggers as well as reactions to blog posts can be diverse. While science blogs can indeed seem to be 'virtual water coolers' around which scholars have informal conversations about their research [15], at least some of them fulfill other communicative functions — by inviting people from outside their field of expertise to join the discussion. In times of acute risk or crisis, blogs can rapidly provide information and advice to people trying to cope with the situation they find themselves in. Results of the present study indicate that this sort of interaction between science bloggers and their audience occurs most easily when the topic of the blog post potentially concerns large groups of people or well-established and/or deeply entrenched controversies are at the center of a post. In addition, it helps to engage a wide group of readers if bloggers explicitly write their posts for a lay audience. The topic and language of the post influence how readers comment on a blog, and they likely also influence who reads them in the first place. Apparently, a blogger's aims play an important role in determining what uses readers can make of a science blog.

If bloggers adopt an engaging style and blog about the appropriate content, science blogs can bypass the traditional channels through which science and research is relayed to the public and further the 'democratization of science' [37, 38]. Until recently, the public's need for information about causes and effects of natural or environmental disasters, for instance, was answered primarily by science journalists via mass media. While the relationships between journalists and academics are not without strains [24], science blogs may be beneficial for both groups in their effort to inform the general public. In blogs, scholars decide what and how they want to write, and they alone are responsible for the quality of the information. Such blogs then are a potential source for journalists and can lead to fruitful interactions [23]. Yet while the use of blogs has increased in a variety of scholarly contexts, a number of issues have prevented science blogs from achieving wide-spread success and it is unclear what role exactly they will play in the future.

Our survey of the scilogs.de authors highlights bloggers' interest in exchange with others about their field of expertise, going far beyond academic audiences. On the other hand, our case studies on acute events of risk and crisis, and of political or societal relevance highlight the need for timely information about scientific issues, presented by experts, in a language, format, and discursive space that enable a lay audience to participate. Parts of the scientific blogosphere apparently already answer to these needs for interaction between scholars and laypersons. But bloggers often report that a learning process was necessary that sets in through the reactions (or lack thereof) they receive for certain features of their blog [19, 26]. For some of them (for instance astronomer Florian Freistetter from the blog 'Astrodicticum Simplex' on scienceblogs.de), this may turn to a professionalization of blogging, communicating about science and research as a career. In other circumstances, bloggers may give up this activity if it fails to serve the function they hoped it would have. Blogs are therefore likely to continue fulfilling different roles

in the communication ecology of scientists, and studies of science blogging should take the resulting different conceptualizations of this form of communication into account.

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