

**External Science Communication by High Profile Digital Native
Researchers: Engagement and Attitudes
(PS 61)**

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Abstract

New online and offline formats allow researchers to target non-specialist audiences directly. This study focuses on the narrow group of future principal investigators and professors in STEM fields and in economics. We report online survey data of 856 high-profile researchers born 1981 or later. These ‘digital natives’ among the very distinguished scientists in their respective fields have a positive attitude towards external science communication and its significance. Interestingly, digital formats such as social media, blogs, podcasts, and web videos do not play a significant role in their personal external science communication.

Keywords

external science communication, digital natives, social media, public engagement, March for Science, science and society

1. Introduction

The field of external science communication (ESC) – in the current paper understood as any communication about science directed to a non-specialist audience – has strongly evolved in recent years. Alongside traditional formats of ESC such as the popular lecture or the

popular book, new formats like the café scientifique (since 1998), the children’s university (2002) or the science slam (2006) have emerged. Above all, numerous new digital formats have evolved, including science blogs, discussion groups in social networks, and science videos on portals such as YouTube or Facebook. These digital formats can be used by all actors in the field of science communication: scientists themselves, public relations workers at research institutions, journalists, and any other individuals or groups who do not belong to any of these three groups (Könneker, 2017, see Figure 1).

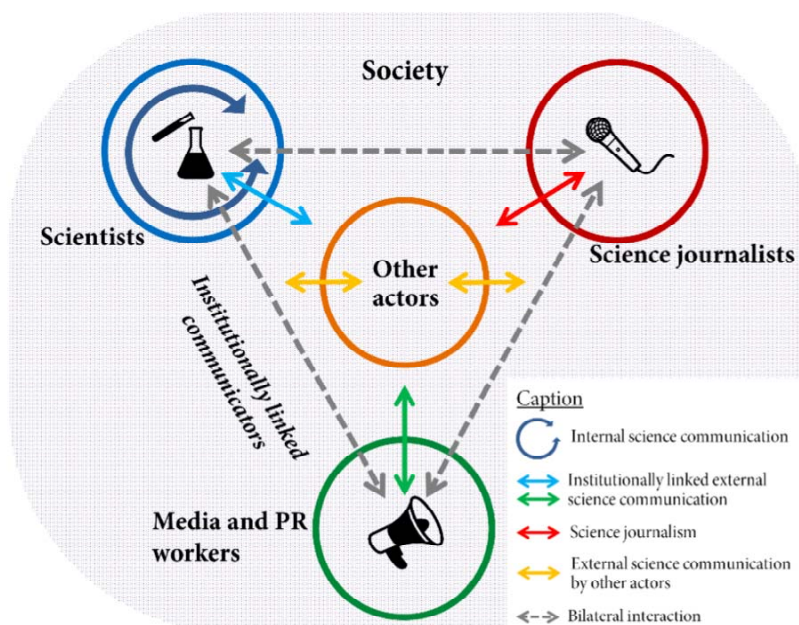


Figure 1. Map of science communication

While the mass media and journalists played a dominant role in drawing the public picture of science during the twentieth century, digital formats nowadays allow researchers to influence the public discourse about science more directly. Researchers can now pursue their interests in the public sphere in an unmediated fashion and directly engage in dialog with laypeople through various social media (Könneker and Lugger, 2013). This has led to a significant shift in the balance of power in favor of the researchers, as well as science marketing and PR (Bauer, 2013; Dudo, 2015).

Various calls from individuals (Cicerone, 2006, 2010; Leshner, 2003, 2015; McNutt, 2013; Reddy, 2009; Rowland, 1993) as well as from institutions (Max Planck Society et al., 1999, 2009; The Royal Society, 1985, 2006) have encouraged scientists to strengthen their public engagement. The arguments for more engagement include the asserted need to provide society with deeper insight into scientific processes and the challenges arising from science as well as the necessity to anchor science better in society. One can summarize the former arguments under the headings of greater transparency and understanding, the latter under greater participation and legitimation. At the same time, many citizens prefer hearing about science from scientists themselves (European Commission, 2007: page 40, 2013: page T11). In recent times, ESC has increasingly been promoted as a means to counter populist, anti-scientific or anti-enlightenment societal tendencies, particularly in the context of the “March for Science” on 22 April 2017 (Nature, 2017).

But to what extent are scientists personally committed to ESC, and what are their motives for public engagement? In recent years, several large surveys have investigated the attitudes of scientists to ESC, the formats they use for ESC, and the time they spend on it in addition to research, teaching, and administrative work (Bauer et al., 2011; Besley, 2015; Johnson et al., 2014; Lo, 2016; Peters, 2013; Peters et al., 2010; Rainie et al., 2015; The Royal Society, 2006). Despite the diversity of the samples, studies consistently report that most scientists regard ESC as important and most are actively engaged in it in one form or another.

However, there seem to be age and gender (and perhaps national context) differences. Among UK scientists, junior researchers are less likely to engage in ESC than their elders (Bauer and Jensen, 2011; The Royal Society, 2006), whereas among U.S.-based AAAS members, younger researchers engage more in ESC than older ones do (Besley, 2015; Rainie et al., 2015). One meta-analysis concluded that younger scientists did not dedicate themselves more to ESC than older ones (Peters, 2013). Further, while two studies found that female scientists were more engaged or at least more interested in ESC than their male colleagues (Johnson et al., 2014; Rainie et al., 2015), a survey which focussed on online engagement concluded that men were more likely to say they would be willing to contribute to ESC (Besley, 2015).

Some studies show that online ESC formats, and especially engagement in social media, are of minor importance. One such study, among scientists of all age groups in the U.S., Taiwan, and Germany, indicated that blogging plays an only limited role in ESC (Lo, 2016). Surveys among U.S.-based AAAS members did not show an increasing significance of science blogging from 2009 to 2014 (Rainie et al., 2015). 77% of them say that promoting their findings on social media is not too or not at all important for career advancement in their respective specialties, though younger scientists regard social media as more significant to their future scientific careers than do older scientists (Rainie et al., 2015).

The studies mentioned above have heterogeneous samples and results, and are thus of limited predictive value. For this reason, we focus on young, high-profile researchers who grew up in the so-called digital age. Our sample comes from internationally recruited researchers who have participated in the Lindau Nobel Laureate Meetings or the Heidelberg Laureate Forum. Attendees of these prestigious conferences in economics and STEM fields are given an opportunity to network with renowned prize-winning scientists and with each other. Interest in the media, or even a commitment to ESC, play no particular role in the multi-step application and selection process for those invited to the conferences, which have been held since 1959 (Lindau) and 2013 (Heidelberg). We therefore see such participants as representatives of the generation of future principal investigators and professors.

We use the notion of “digital natives” and – following Palfrey and Gasser (2008: page 1) – only analyzed high-profile researchers born 1981 and later.

Our interest is the extent to which the digital natives among these excellent scientists in STEM and economics fields engage in various digital and non-digital media formats, and what their attitude to ESC is.

2. Methods

We conducted online surveys in 2014, 2015 and 2016 of high-profile digital native researchers using the Electronic Fields Survey (EFS) software (Jacob et al., 2011: page 121- page 122). The survey focused on:

a) The engagement of the responding scientists in ESC. Participants answered the question: “How often have you engaged in the communication of science [...] in the last 24 months?” The item was measured on a scale with four options which ranged from “never” to “more than six times”.

b) Scientists’ use of 12 different ESC formats, including giving readily understandable talks for a non-specialist audience, writing press releases, or operating a weblog. They answered the question: “How often have you used the following formats for your own communication of science during the last two years?” Again, the items were measured on a scale with four options ranging from “never” to “more than six times”.¹

c) Scientists’ agreement with specific statements concerning science communication such as “Communicating science is fun” or “A great obstacle in communicating science is the lack of public interest”. Respondents answered the question: “To what extent do you agree with the following statements?” Each Likert-type item was measured on a five-point scale ranging from “completely disagree” to “completely agree”. Respondents could choose “unable to answer”. The statements were derived from the discourse on science communication in Germany in recent years (Acatech et al., 2014; Marcinkowski and Kohring, 2014).

As noted above, all the survey participants were high-profile researchers selected as participants of the Lindau Nobel Laureate Meetings or the Heidelberg Laureate Forum. In the years we surveyed, the Lindau meetings focused on physiology/medicine, on physics, on chemistry, and on economic sciences (Council for the Lindau Nobel Laureate Meetings e.V., n. d.). At the Heidelberg forums, the focus was consistently on mathematics and computer science.

¹ With respect to the formats of weblog, audiocast and videocast, a slightly differently formulated question was asked: “Have you used the following formats for your own science communication in the last two years?” Options for answers included “no”, “yes, with irregular own posts”, and “yes, with regular own posts (at least 1 per month)”.

Survey participants were invited to complete the questionnaire via email by the organizers of the Lindau Nobel Laureate Meetings or the Heidelberg Laureate Forum, respectively.² The survey ended in November 2016, and was not exclusively directed at digital natives.

Participation was voluntary, and data was evaluated anonymously. A total of 893 digital native respondents completed the online survey. After quality control, 856 respondents remained. The mean age was slightly below 29 (SD = 3.02), with 57% male, 42% female. The sample consisted of researchers in technology and engineering (4%), economics (9%), the life sciences (15%), chemistry (16%), and the physical sciences, which in our study also included mathematics and computational sciences (52%). The largest group were either doctoral students (36%) or research associates (33%, with doctorate), and most worked in Europe.

3. Results

3.1. Engagement of digital native high-profile researchers in ESC

91% of the respondents indicated they had used at least one of the communication formats at least once within the previous two years. The average number of formats used was 3.6 (Median = 3, Mode = 2).

As shown in Figure 2, 64% had given a talk for a non-specialist audience at least once, making this by far the most common ESC activity. Less than half the respondents had engaged in any of the other formats. Among the more popular formats were event-based activities, with tours of institutions having been conducted by 44%, and lectures for children by 28% of the respondents. Activities related to journalism were also relatively common: 39% had given interviews, and 29% had written popular science articles.

² Lindau Alumni in physiology and medicine as well as of economic sciences were also invited to take the survey. The same applied to alumni of the first Heidelberg Laureate Forum in 2013.

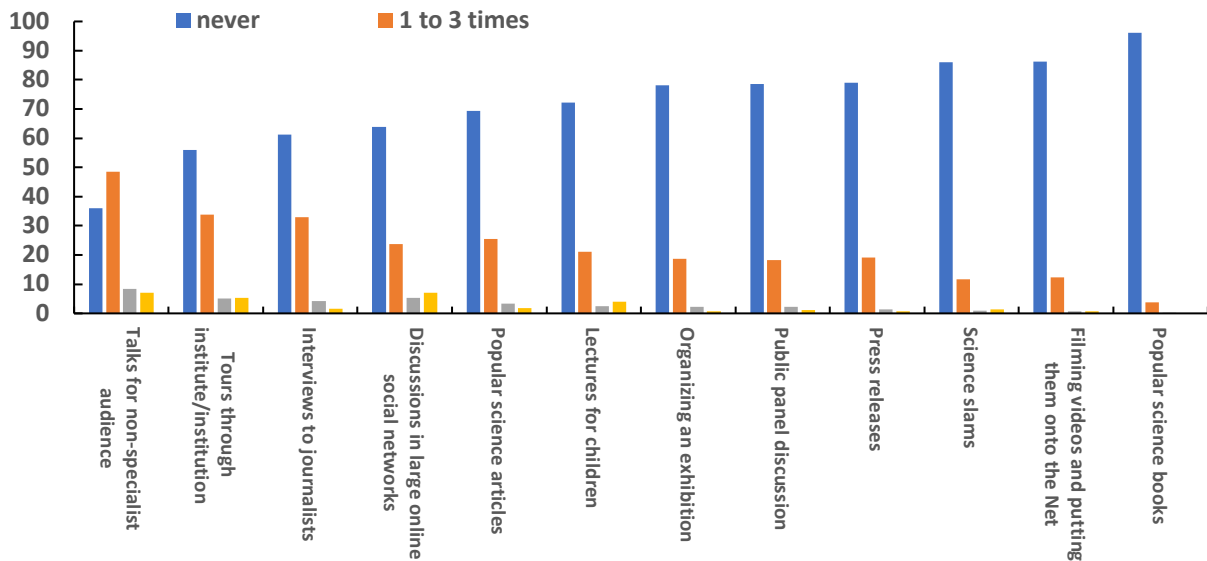


Figure 2. Usage of different formats of external science communication among digital native high profile researchers.

Regarding the use of online-based formats, 36% of the 856 respondents had participated in discussions in large social networks online, such as Facebook or Twitter. 15% had their own weblog, but the vast majority of them did not post on a regular basis. 14% have also already made videos of their research and put them onto the internet, but videocasts and audiocasts play a very subordinated role, with only 2%, and 1%, respectively, employing them.

Figure 2 also shows that if a format was used, then only one to three times in the previous two years. Very few used a single format more often than that. Likewise, only a small minority indicated they had used many formats: less than five percent said they had made use of more than 7 of the 14 formats listed in the questionnaire.

We also explored whether different subsets of the sample engaged in activities more or less frequently. Analyses were confined to the three most widely used formats, and to three of the online formats. Non-parametric tests were used if distribution assumptions of parametric tests were violated.

Table 1 shows the differences between subgroups defined by (a) gender, (b) position and (c) research field. There were no significant differences by gender, but the mean number of ESC

activities did differ significantly by the respondents' position ($F = 2.2, p = .04$), with those in higher positions tending to engage in more activities. However, a post-hoc Scheffé test did not show any significant differences ($|\Delta| < 1.12$ for all mean differences, all $p > .27$).

Table 1. Relationship of engagement in different external science communication activities and scientist characteristics.

	Number of activities ^a	Talks ^b	Tours ^b	Interviews ^b	Online social networks ^b	Videos ^b	Blogs ^b
Gender	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Position	*	n.s.	n.s.	n.s.	n.s.	n.s.	**
Research field	*	n.s.	***	n.s.	n.s.	*	n.s.

Notes. n.s.: not significant; *: $p < .05$; **: $p < .01$; ***: $p < .001$.

^a One-way ANOVAs

^b Mann-Whitney U-Tests for gender, Kruskal-Wallis Tests for other variables

The mean number of ESC activities also differed by research field ($F = 2.57, p = .03$), with 'technology and engineering' tending to have the highest numbers and 'chemistry' and 'other' to have the lowest. However, post-hoc tests again were not significant ($|\Delta| < 1.51$ for all mean differences, all $p > .07$). The difference in giving tours of institutions ($\chi^2 = 35.88, p < .001$), according to the mean ranks, was mostly due to scientists in economics conducting fewer, and scientists in technology and engineering conducting more, tours than scientists in other research fields. The number of respondents operating a weblog differed across academic positions ($\chi^2 = 19.5, p < .01$), with relatively few doctoral students doing so compared to the relatively many assistant professors. All the reported exploratory findings need to be interpreted with care, as we did not control for type I error.

3.2. Attitudes of digital native high-profile researchers towards ESC

The frequency of agreement and disagreement with statements regarding ESC are displayed in Figure 3. As can be seen, 'positive' statements about ESC, meaning statements giving reasons for ESC, were endorsed by most respondents, and 'negative' statements were rejected by a majority. Three items assessed the scientists' views about different obstacles

external science communication faced. By far the most important, at 64% agreement, was simply the lack of time. Far fewer, 34% and 33%, respectively, saw obstacles in the lack of public interest and in scientists' insecurity. Correlations among and between positive and negative items were all significant ($|\ .08 | < r < | \ .34 |$, all $p < .05$). The fact that the correlations are rather small suggests respondents have a rather differentiated picture of ESC, and that the sample cannot simply be divided into a majority with mostly positive and a minority with mostly negative attitudes towards ESC.

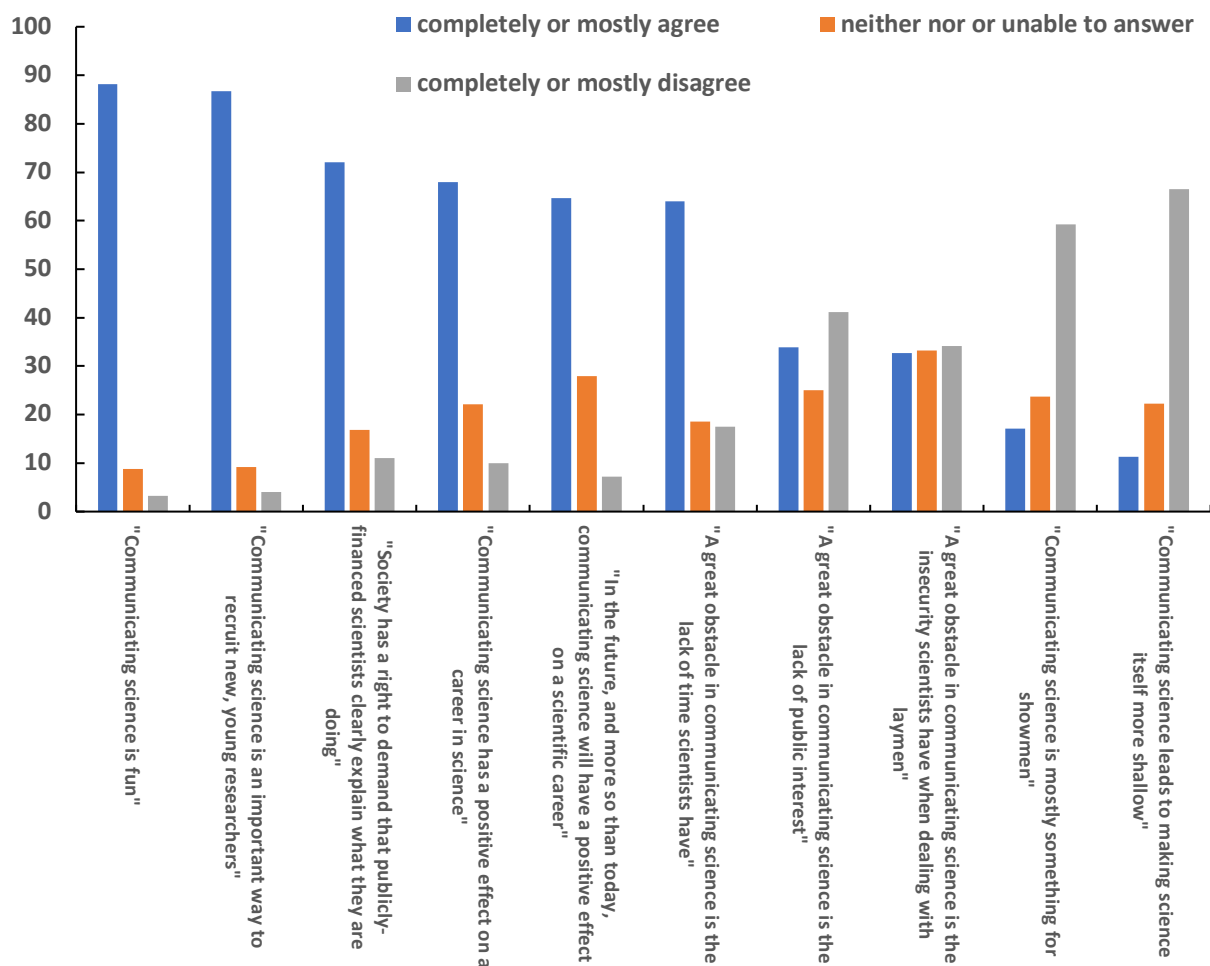


Figure 3. Agreement with different statements regarding external science communication.

As for ESC activities, we also explored the relationship between agreement with the statements and (a) gender, (b) position and (c) research field. A summary of the findings can

be found in Table 2. Regarding gender, men more frequently than women opined that ESC is something for showmen ($Z = -2.29$, $p < .01$). Women, by contrast, thought ESC had more of a positive effect both currently ($Z = -2.2$, $p < .05$) and increasingly into the future ($Z = -2.02$, $p < .05$).

Table 2. Relationship of attitudes towards external science communication and scientist characteristics.

	Fun	Recruitment	Society's right	Effect on career	Future effect on career	Lack of time
Gender	n.s.	n.s.	n.s.	*	*	n.s.
Position	n.s.	n.s.	n.s.	n.s.	*	**
Research field	n.s.	n.s.	**	n.s.	*	*

Notes. n.s.: not significant; *: $p < .05$; **: $p < .01$; Mann-Whitney U-Tests for gender, Kruskal-Wallis Tests for other variables.

Table 2 (continued). Relationship of attitudes towards external science communication and scientist characteristics.

	Lack of public interest	Insecurity of scientists	Showmen	Makes science shallow
Gender	n.s.	n.s.	**	n.s.
Position	*	n.s.	n.s.	*
Research field	n.s.	n.s.	n.s.	*

Notes. n.s.: not significant; *: $p < .05$; **: $p < .01$; Mann-Whitney U-Tests for gender, Kruskal-Wallis Tests for other variables.

Differences also existed between those in higher and lower positions. The former tended to agree more with the statement that a lack of time is an obstacle for ESC than did the latter ($\chi^2 = 18.73$, $p < .01$). Interestingly, compared to researchers with doctorates, those without doctorate saw a greater obstacle in the lack of public interest ($\chi^2 = 14.46$, $p < .05$). There was also a difference in opinion between researchers in different positions about whether ESC itself makes science more shallow ($\chi^2 = 14.06$, $p < .05$) and whether ESC might have a positive effect on a future scientific career ($\chi^2 = 12.70$, $p < .05$). Mean ranks of the different positions did not reveal a clear-cut picture here, however.

Researchers from different fields differed in what they thought about the right of society to be informed about publicly-financed research ($\chi^2 = 17.27$, $p < .01$). Mean ranks of agreement were highest among life scientists and lowest among physical scientists and researchers from ‘other fields’. Furthermore, scientists from different fields differed in seeing a lack of time as an obstacle for ESC ($\chi^2 = 14.04$, $p < .05$, life scientists and ‘others’ with the highest mean rank, and economists with the lowest), the degree to which they thought ESC makes science itself more shallow ($\chi^2 = 13.87$, $p < .05$, economists showing the highest mean rank, and life scientists and physical scientists the lowest) and the degree to which they agreed that ESC would have a positive effect on scientists’ future careers ($\chi^2 = 12.05$, $p < .05$, with scientists from technology and engineering having the highest mean rank, and economists the lowest).

4. Conclusions

The focus of our study was on the nature of engagement in ESC on the part of high-profile digital native researchers in STEM areas and economics. We were also interested in the attitudes of these future principal investigators and professors towards science communication. While there are limitations related to the sample used, as well as related to the exploratory character of the study, the results give some insights which are relevant to the ongoing public debate about the role of ESC:

1. Nearly all the respondents (the researchers who participated in the survey) engage in ESC – but only to a modest extent.
2. Most have clearly positive attitudes about ESC and its importance.
3. Those from different disciplines differ in their attitudes toward, and engagement in, ESC.
4. On average, researchers use three to four different ESC formats. There is no gender gap in how engaged researchers are, but there are some gender differences visible in attitudes towards ESC.
5. Scientific socialization (i. e. academic position) has an impact on the degree of engagement in ESC as well as on the attitudes towards ESC.

6. Interestingly, digital natives are not digital when it comes to ESC. More traditional (offline) formats are used more often than digital opportunities provided by weblogs or social media. Although new online formats are an opportunity to interact in an unmediated manner with the public, the vast majority of high-profile digital native scientists apparently do not seize this opportunity. Our data thus does not support the common assumption that new online formats play an important role for the purportedly growing relevance of scientists in ESC (see Bauer, 2013).

Declaration of Conflicting Interests

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