RESEARCH ARTICLE

Engaging bioscientists in science communication: Evidence from an international survey [version 1; peer review: 1 not approved]

Andrea Boggio¹ , Giorgio Scita², Carmen Sorrentino², David Hemenway³, Andrea Ballabeni³

¹Department of History and Social Sciences, Bryant University, Smithfield, RI, 02917, USA

²IFOM - The FIRC Institute of Molecular Oncology, Milan, 20139, Italy

³Department of Health Policy and Management, Harvard T.H. Chan School of Public Health, Boston, MA, 02115, USA

V1 First published: 02 Mar 2017, 6:209
<https://doi.org/10.12688/f1000research.10842.1>

Latest published: 02 Mar 2017, 6:209
<https://doi.org/10.12688/f1000research.10842.1>

Abstract

Background: Exchanges between scientists and nonscientists are critical to realizing the social value of basic research. These exchanges rest in part on the willingness and ability of scientists to engage effectively in science communication activities. In this paper, we discuss the perception and willingness of basic scientists in the biological and biomedical fields to engage in science outreach.

Methods: The analysis is based on qualitative data collected as part of a survey on the social value of basic research and is framed by the theory of planned behavior. This is a well-established theory of human behavior that relies on the premise that a person's intention to engage in a behavior is the single best predictor of whether that person will in fact engage in that behavior. **Results:** Our data show that, while bioscientists maintain a positive attitude towards science communication, their intentions are influenced by some negative feelings with regard to how nonscientists react to science communication efforts. Interactions with institutional actors, governmental bodies and the public are particularly problematic. On the other hand, interactions with clinicians and patients are framed in positive terms. Finally, some study participants raised concerns as to their ability to communicate science effectively, the availability of time and resources, and the lack of proper rewards, particularly in terms of career advancement, for those who engage in science efforts.

Conclusions: Our findings suggest that bioscientists' intentions to engage in science communication efforts must be better studied to develop empirically-informed interventions to increase scientists' participation in science outreach efforts.

Peer review discontinued

At the request of the author(s), this article is no longer under peer review. [What does this mean?](#)

Approval Status

	1
version 1
02 Mar 2017	view

1. **Vickie Curtis** , University of Glasgow, Glasgow, UK

Any reports and responses or comments on the article can be found at the end of the article.

Keywords

Science communication, publicly-funded research, biomedical research, theory of planned behavior, qualitative data, usability gap, social value of science, interaction experts/publics

Corresponding author: Andrea Boggio (aboggio@bryant.edu)

Competing interests: The authors declare no competing interests.

Grant information: Andrea Ballabeni and Carmen Sorrentino were funded by Cariplo Foundation (grant #, 2015.0081).

Copyright: © 2017 Boggio A *et al.* This is an open access article distributed under the terms of the [Creative Commons Attribution License](#), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. Data associated with the article are available under the terms of the [Creative Commons Zero "No rights reserved" data waiver](#) (CC0 1.0 Public domain dedication).

How to cite this article: Boggio A, Scita G, Sorrentino C *et al.* **Engaging bioscientists in science communication: Evidence from an international survey [version 1; peer review: 1 not approved]** F1000Research 2017, 6:209
<https://doi.org/10.12688/f1000research.10842.1>

First published: 02 Mar 2017, 6:209 <https://doi.org/10.12688/f1000research.10842.1>

Introduction

Science communication refers to the “use of appropriate skills, media, activities and dialogue to produce one or more of the following personal responses to science: awareness, enjoyment, interest, opinion-forming and understanding” (Burns *et al.*, 2003: 183). Effective science communication is seen as an important science policy tool, as it enables exchanges between scientists and nonscientists that are critical to transforming basic research into social outcomes (Bozeman, 2007; Bozeman & Sarewitz, 2011). After reviewing the empirical literature on the connections between research and societal application, Sarewitz & Pielke (2007: 7) conclude that “one feature that invariably characterizes successful innovation is ongoing communication between the producers and users of knowledge.” Producing valuable knowledge alone is in fact not sufficient to realize the public value of basic research; to transform basic knowledge into concrete social outcomes, basic research findings must be properly communicated to nonscientists and the latter must use these findings to generate social outcomes.

Unfortunately, studies show that effective communication between scientists and nonscientists is not the norm. This has resulted in a ‘usability gap’ (Kirchhoff *et al.*, 2013) that prevents basic research from becoming fully realized into concrete social outcomes. Scientists’ behavior is certainly an important determinant of this usability gap. Scientists can in fact contribute to closing this gap by engaging in science communication. Unfortunately, we know that scientists’ engagement in science communication activities is far from optimal and that scientists could be engaged more frequently and more effectively (Bruine de Bruin & Bostrom, 2013; Bucchi, 1998; Hilgartner, 1990; Pielke, 2012; Rödder *et al.*, 2012; Suldovsky, 2016). Consequently, understanding scientists’ attitudes towards science communication activities is critical to designing policies that enhance their commitment to science communication activities.

In this paper, we analyze qualitative data gathered in conjunction with a large survey of scientists who are researchers in Italy, the United Kingdom, and the United States, using the theory of planned behavior to understand scientists’ perception of science communication activities. The goal is to understand which scientists’ perceptions influence their decision not to engage in science communication activities and to suggest policy interventions that would modify those perceptions and increase scientists’ participation in public engagement of science.

Methods

Study context

The theory of planned behavior is a well-established theory of human behavior, which relies on the premise that a person’s intention to engage in a behavior is the single best predictor of whether that person will in fact engage in that behavior. According to the theory, intentions, and consequently, behavior are influenced by three sets of variables: attitude towards the behavior, subjective norms, and perceived behavioral control (Ajzen, 1991). Attitude towards the behavior is the degree to which performance of the behavior is positively or negatively valued by an individual. This attitude is in turn determined by behavioral beliefs—the subjective

probability that the behavior will produce a given outcome—that link the behavior of interest to expected outcomes. Behavioral beliefs are based on personal experience, information sources and inferences. Subjective norms reflect an individual’s perception of social pressures to engage or not to engage in a behavior. This variable is linked to the degree to which certain groups of people approve or disapprove of the individual performing the specific behavior and how social pressure informs subjective perception about the particular behavior. Perceived behavioral control refers to a person’s perception of her ability to perform a given behavior. This variable is linked to the perceived ability to engage in a behavior and to the ability to do so effectively (Ajzen, 1991).

Planned behavior theory in particular has provided a fertile framework for empirical research in scientists’ participation in public engagement activities (Besley *et al.*, 2013; Dudo *et al.*, 2014; Dudo & Besley, 2016; Poliakoff & Webb, 2007). Poliakoff & Webb (2007: 254) have applied this approach to investigate the determinants of scientists’ intentions to participate in public engagement activities. Based on an ‘augmented’ version of the theory of planned behavior, the two authors show that scientists’ intentions are determined by past experiences with public engagement, attitudes towards engaging with the public, perceived control that scientists can exercise on public engagement activities, and beliefs about colleagues’ participation in public engagement. Poliakoff and Webb also conclude that career recognition, availability of time and other constraints do not significantly predict intentions to engage in public engagement of science activities. Using data from two large surveys of scientists from the United States and the United Kingdom, Besley *et al.* (2013) found that a personal commitment to the public good and feelings of personal efficacy and professional obligation can predict scientists’ involvement in outreach activities. Dudo *et al.* (2014) found that predictors of nanoscientists’ involvement in science communication include perceiving public communication as important for the welfare of society, seeing professional benefits from generating publicity about their research, and spending more time using online tools. These results were in great part replicated by Aykurt (2016), who conducted a similar study among nonscientists in Denmark. Interestingly, the study also found that a lack of time is an obstacle to engaging in science communication using online tools (Aykurt, 2016: 44). Finally, in researching how scientists prioritize science communication objectives, Dudo & Besley (2016) found that informing the public, exciting the public, building public trust about science, and defending science from public misinformation are objectives that received the largest support among study participants. The fact that these objectives are important to scientists certainly has implication to their intention to engage in science communication: scientists may be more willing to engage if they perceive that science communication efforts prioritize the right objectives.

Methodology

With this framework in mind, we analyze how the three variables deployed by the theory of planned behavior contribute to our understanding of scientists’ intentions to participate in science communication activities. Our analysis is based on qualitative data that we gathered in conjunction with a large survey of scientists conducting basic research in the biomedical field in Italy,

the United Kingdom, and the United States¹. The survey focused on the attitudes and beliefs of scientists towards policies that could incentive the types of basic research with the highest likelihood of creating public health benefits². While the survey did not focus directly on science communication, many study participants shared their perception of science communication activities in a *Comments* section that they could fill out after completing the survey. The section reads as follows:³

COMMENTS: Do you have ideas about other policies that can increase both the societal benefit potential of basic research and the scientist satisfaction, without affecting the fundamental nature of basic investigation? You can use this space to tell us about them or for any additional considerations related to the themes of this survey.

Participants were recruited by email, and, after consenting to participating, asked to confirm their status as basic researchers and identify their position/role within the respective organizations. Respondents could indicate their geographical location, but not their institution. They could skip any questions, including the *Comments* field⁴. Out of the 7,786 invitations that were sent between August 24, 2015 and October 10, 2015, 885 recipients filled out the entire survey and, among them, 145 participants filled out the *Comments* field⁵. *Comments* are presented, along with all responses to the entire survey, in the Final report in the Data availability section. The majority of 145 respondents were male (64%) and PIs (71%). In total 60% were based in the US (50 in Los Angeles-San Diego and 34 in New York City), with the remaining split between the UK (36) and Italy (20) (Table 1).

All *Comments* were imported into MAXQDA (ver. 12.1; <http://www.maxqda.com/>), a qualitative data analysis software, to be analyzed. We then conducted a three-step analysis the data. In Step 1, we coded segments ‘*in vivo*’ based on the ‘first-step coding,’ a code system that we had used to analyze qualitative data in a previous study exploring similar issues (Boggio *et al.*, 2016). The ‘first-step coding’ schema is available as Supplementary File 1.

During Step 1, we discarded 12 of the 145 answers because respondents either commented on the survey design or merely thanked us for conducting the study. In Step 2, we reviewed the results of the first-step coding to identify clusters of data that could lead to further insights when analyzed in conjunction with the theory of planned behavior. In Step 3, we proceed to analyze the data clusters, identified as a result of Step 2, based on the three main parameters of the theory of planned behavior: attitudes, subjective norms, and (perceived and actual) behavioral control. This analysis was conducted by sifting through the material, highlighting text, terms, and phrases, writing notes, and reorganizing coded segments along the three parameters. Finally, we reviewed the results, reflected on the data, and constructed narratives that would convey study respondents’ attitudes towards science communication activities. While focused primarily on the qualitative data, the analysis is mindful of the quantitative findings of the survey and we occasionally refer to the quantitative findings to provide the appropriate research context for our analysis.

Results

Bioscientists’ attitudes towards science communication

Initially, we analyzed responses that provide insights as to the degree to which scientists positively or negatively value engaging in science communication activities. Overall, respondents expressed positive attitudes towards science communication.

With regard to *content* of science communication, many respondents indicated that science communication should be preoccupied to correcting misunderstandings about the social value of science and to fostering a deeper understanding of the public value of science. Since society often fails to fully appreciate basic science’s potential to contribute to social outcomes, science communication should firstly aim at “increasing people awareness of the contributions of basic research to our daily lives” (#191)⁶ and foster “much more interaction between society, scientists and sufferers” (#160). As one respondent put it, science communication must answer the question “What is the point of this research?” so that “everyone can understand why they are doing this research and why it will be a benefit to us” (#222). Secondly, science communication is also an opportunity to address negative perceptions of science. “With the current challenges about data replication in the popular press, good communication has never been more vital” (#116). Patients, some scientists worried, “do not understand the real role of bio-science for the general health [and think negatively of] animal experimentation, drugs in general and natural cures (that there are not miraculous cure of cancer)” (#133). Thirdly, many respondents also indicated that, if science were better understood, the public would be more willing to support basic research. To foster public support of science “the benefits of basic research are fed back to the people who in the end are funding the research” (#216). Others favored communication efforts that focus on “non-instrumental” aspects of science (#118 mentioning astronomy as “very popular, even though it has no direct economic benefit”), the complexity and mystery of scientific inquires (#176: “science is a process that takes time and hard work and great thoughtfulness, not just a received body of ‘facts’ that one is supposed to memorize”), and science as “awesome and fun” (#150). The last respondent also added that “we need to get away from the pure health focus of research: in

Table 1. Study population. LA = Los Angeles-San Diego; LN = London-Cambridge; MI = Milan; NY = New York City.

	LA	LN	MI	NY	N/A	Total
NON-PI	16	10	7	9	1	43
F	4	4	1	4		13
M	12	5	6	5	1	29
N/A		1				1
PI	34	26	13	25	4	102
F	11	8	3	11	1	34
M	22	18	9	12	3	64
N/A	1		1	2		4
Grand total	50	36	20	34	5	145

neuroscience all the promises of the decade of the brain were bad public policy. Let us not repeat that mistake over and over again!" (#150). "Good science is similar to painting or composing music, but the tools are different" (#166).

Our respondents expressed different attitudes depending on the *audience* of science communication. Exchanges with clinicians and patients received an assessment that is more favorable. By contrast, the relationship with policymakers, politicians, and the media were mostly framed in negative terms (we discuss policymakers, politicians, and the media under 'perceived behavioral control'). With regard to clinicians, more than 20 of the 133 comments remarked that interactions between basic scientists and clinicians are beneficial in two ways. First, scientists can benefit from clinicians' feedback. Due to the "constant patient and clinician contact," the clinical environment may generate "a good amount of feedback into the direction of the science" (#184). In addition, interactions with basic scientists may reorient clinicians' focus from "treatment of symptoms ... to understanding disease [since] basic research tends to want to understand how things work" (#139). Second, clinicians can become agents of science when communicating with other users (colleagues and patients) (#215: "MDs have key role to play in supporting/communicating basic research"). Similarly, interactions with patients are perceived as positive. To stimulate these exchanges, study participants supported the proposal to relocate some basic researchers into hospitals and suggested that scientists should get actively involved with clinical care to generate more opportunities for knowledge exchanges⁷. They also noted though that more needs to be done for science communication to happen in the clinical environments. "Simply having basic scientists at hospitals does not help if they are not actively involved with clinical problems" (#244). Cultural barriers may be an obstacle to knowledge exchanges, since clinicians and scientists come from different cultural worlds, and their exchanges would improve if their educational paths—e.g. a PhD in biology or an MD for clinicians—overlapped more.

There is huge knowledge gap between basic science and medical or clinical research although we start our education with same knowledge of biology, chemistry etc. To tackle this problem, syllabus for basic science or medicine should have some overlapping subjects. (#112)

A different picture emerges from the analysis of comments involving the media and policymakers. Media are perceived as agents of distortion: the information that the media feed to the public does not accurately portray how scientific research is conducted and how it contributes to the betterment of society. Some imputed this state of affairs to the fact that "the media are for the most part corporate and can say/show what they want" (#146) and to the fact that the media engage in "false equivalence giving equal weight to dubious if not downright false opposing viewpoints" (#141). Against this background, the media are nonetheless perceived to play a critical role in science communication efforts.

I think the media could really help by reporting the origins of progress in terms of the basic science and scientists that initiated and brought to fruition a finding, even if it is not world-shattering progress. The public needs to be educated about the scientific

method and how failed hypotheses lead to new insights that can change the world. For example, the discovery of miRNA – how it occurred and where it has led would help people understand the value of basic research. I am a glycobiologist and have determined many functions for sugars attached to glycoproteins. Even most scientists do not appreciate the importance of sugars on glycoproteins. Understanding how they are useful in recombinant therapeutics that treat disease would be helpful to the general public as it would be a lesson in how to think scientifically. (#219)

The media should thus "promote well-informed discussion of basic research discoveries and their contribution to knowledge in the media" (#230) with "accuracy of portrayal" (#108). Policymakers are also perceived negatively. The respondents questioned policymakers' ability and willingness to understand and embrace science. "The ignorance of a large portion of the general public is terrible, especially members of Congress" (#208).

Overall, negative attitudes seem to be grounded on scientists' perception that the public lack sufficient scientific literacy. In fact, many respondents expressed the wish to have policymakers—politicians in particular—with better science credentials and more willingness to understand science ("Need more policy makers who are scientifically literate, with some experience in basic science not simply owning medical degrees" #107). To address the scientific literacy deficit, respondents proposed various improvements that could change their attitudes towards communicating knowledge to nonscientists. Improving education in science and technology seems to be a clear target to enhance science communication. Curriculum reform at all levels of education was proposed by numerous respondents. Curricula, some participants suggested, should emphasize how the scientific process works and how scientific findings benefit society. Scientific literacy would improve "if future generations are more aware of the scientific process" (#234). Scientific education should start at an early age—"get kids into science. That's the only way to change the mindset of the generations" (#220). Also, "make sure all children have introduction to biology, chemistry, physics and human physiology; emphasize scientific process and benefit of scientific research" (#111). Curricula should also "showcase how basic science has paved the way for translational science" (#129). Children's interest should be also fostered outside the classroom by having the right kind of programs and initiatives ("Bring back Bill Nye, The Science Guy, to public television; and/or promote TV/movie with scientists as protagonists to encourage more children to pursue STEM education and careers" #120). In addition to triggering interest in science, these initiatives would forge more informed citizens and better policymakers ("An unprepared mind will be unprepared for the proposed policies" #199). To some, curriculum reform is arguably more important than having career scientists engage the public since "much promotion of research by even highly regarded scientists does not serve the knowledge/long term interests of the public that well" (#235).

Subjective norms

We then turned to analyzing responses that address the normative beliefs and subjective norms held by bioscientists. These are comments that concern whether bioscientists are expected to engage

in science communication activities and how individuals perceived those expectations. Participants seem to be in agreement that bioscientists are *expected to engage* with the public. Furthermore, many argued that bioscientists ought to become *more engaged* with science communication efforts and take greater ownership of these efforts. This is part of their professional obligation, especially where research is publicly funded. “Since the public funds the research in many cases, scientists have an obligation to educate the public and to deliver new knowledge to them” (#111). Bioscientists must get involved “in the training of media-relations personnel (i.e. journalists), of both trainees in the discipline (e.g. classroom settings of journalism schools) and of active journalist (e.g. through seminars or workshops)” (#177).

Respondents also identified various institutional and professional opportunities for greater engagement with science communication. Organizing meetings and open houses, an option directly asked about in our survey, is one. Institutions could organize “periodic open house type of event where basic scientists could explain their science to general public, entrepreneurs, clinicians” (#170). These events are also seen as opportunities for scientists to reflect on their work and “think about potential societal benefits just by interacting with people in different background and educational qualification” (#170). Professional organizations are seen as science communication tools: “professional societies could do more societal outreach” (#154). However, some argued, these organizations need to change their approach to be effective: “Scientific societies need PR and even something like political operatives to expose industry and anti-science groups for their agendas and questionable credentials. Instead of not engaging or expecting some sort of even playing field, scientific associations need to get media savvy and do more to reclaim what science stands for and represents” (#141). Finally, respondents mentioned publication outlets as valid communication tools. Open access journals in particular offer opportunities for disseminating science and for the public to appreciate that public funds are used in ways that lead to beneficial social outcomes—or “to see their tax dollars at work” as one respondent put it (#200). The idea of an online forum “where people feel safe to ask ‘stupid’ questions” (#210) was also brought up.

Perceived and actual behavioral control

Finally, we analyzed answers to find insights concerning bioscientists’ behavioral control. This variable refers to perceived and actual ability to engage in science communication activities. Bioscientists’ lack of skills to communicate science effectively was mentioned several times as a source of inability of bioscientists to communicate science effectively. As a solution, respondents proposed offering proper training to scientists, but also choosing only the most “effective communicators to engage with the public and media” (#243). “Train early career scientists to communicate with the public [and] include training in communication tools and public speaking during postdoctoral training” (#196). More importantly, respondents felt that they are unable to participate in public engagement of science because of perceived environmental constraints, such as time and resources. To them, these constraints constitute actual barriers to greater involvement with science communication. “Overburdened schedules” (#154) force bioscientists

to struggle with keeping up with the day-to-day work of scientific research. Demands for greater commitment to science communication efforts means asking them to reduce the time and energy spent responding to the demands of today’s academic environment, where ‘publish or perish’ is the norm. Scientists’ perception is that it is simply impossible, especially considering that engaging with the public does not lead to immediate returns in terms of productivity and career outcomes. “You are raising the possibility of more sessions, more discussions, more meetings (etc.) for persons who already do research into the late hours, are involved in classroom teaching, do university administration, and instruct people in the lab” (#181). This cannot be done without increasing funds, available to scientists, labs and institutions, to pay for outreach and communication efforts, or setting up direct rewards (in the form of career advancements, credit recognition in grant reviews or prizes) for scientists who engage in such efforts. Otherwise, the risk is that further demands may “drive good scientists away from science” (#181).

Discussion

In this study, we investigate how bioscientists perceive science communication activities with the understanding that science communication is instrumental to realizing the social value of basic research, and that perceptions influence the decision to engage in these activities. According to the theory of planned behavior, our data show that bioscientists’ perception of science communication may influence their decision to get involved with public engagement activities. Consistent with previous research (Corrado *et al.*, 2001; Poliakoff & Webb, 2007), bioscientists maintain a positive attitude towards science communication as a tool that can enhance how science is understood and valued in society. Contrary to previous studies (Poliakoff & Webb, 2007), we found that subjective norms play a role as determinants of scientists’ participation. In fact, bioscientists appear to feel required to engage in exchanges with nonscientists. Furthermore, direct previous experiences with science communication activities were barely discussed, suggesting that they do not play an important role in determining participation, contrary to Poliakoff & Webb (2007). Occasionally respondents referred to indirect experiences, such as observing how nonscientists react to science communication efforts. Reported reactions are mostly negative: bioscientists’ perception is that nonscientists are ordinarily not positively impacted by science communication activities.

This leads to another important finding, which is currently not documented in the literature: interactions with certain nonscientists are valued more than with other nonscientists. In particular, exchanges with clinicians and patients are valued more than interactions with institutional actors, governmental bodies and the public. Institutional actors, governmental bodies and the public are perceived as lacking sufficient scientific literacy to appreciate science, which makes bioscientists feel powerless. Engaging with this group of actors may be of little value because bioscientists feel they cannot change their understanding of and appreciation for science. On the other hand, interactions with clinicians and patients are perceived as more promising, since these exchanges can lead to mutual benefit: scientists would gain a better understanding of how science is translated into application; clinicians would

be less focused on symptom treatment and more on understanding the underlying causes of disease; and patients would better understand what knowledge is behind a certain treatment.

Finally, perceptions relating to perceived behavioral control matter. Some bioscientists feel that they are not able to contribute effectively to science communication activities because they lack either the skills needed to communicate science effectively or the time and resources that would be needed. In addition, bioscientists feel that involvement with science communication is not properly rewarded, particularly in terms of career advancement. Perceptions of the lack of adequate training are not new (Corrado *et al.*, 2001; Gascoigne & Metcalfe, 1997; Poliakoff & Webb, 2007). Similarly, many accounts of contemporary experience in academia focus on well-documented and debated systemic problems (Alberts *et al.*, 2014; Alberts *et al.*, 2015), which relates to how basic science is funded (Martinson *et al.*, 2009), scientific merit is evaluated (Siler *et al.*, 2015), scientific findings are published (Vale, 2015), and younger scientists are offered opportunities for career growth (Daniels, 2015; McDowell *et al.*, 2014). Not surprisingly, these issues were brought up in the survey as challenges that prevent bioscientists from engaging further in science communication activities.

Conclusions

Exchanges between scientists and nonscientists are critical to realizing the social value of basic research. These exchanges rest in part on the willingness and ability of scientists to engage effectively in science communication activities. Our study suggests that bioscientists are supportive of greater participation in public

engagement of science and that they particularly value interactions with clinicians and patients. However, their commitment appears to be constrained by their limited confidence in their ability to effectively communicate science, as well as the perceived lack of time and resources to engage with nonscientists. These problems are not new, and are not insurmountable. Solutions must be empirically-informed interventions, in order to reduce the obstacles that bioscientists perceive as preventing them from getting more involved with science communication efforts.

Data availability

Questions and responses of the survey are available on F1000Research: doi, [10.5256/f1000research.7683.d110888](https://doi.org/10.5256/f1000research.7683.d110888) (Scita *et al.*, 2016a)

Author contributions

Study design: Andrea Ballabeni, David Hemenway, Giorgio Scita. Data collection: Andrea Ballabeni, Stefano Confalonieri, Carmen Sorrentino. Data analysis and first draft of the manuscript: Andrea Boggio. All authors were involved in the revision of the draft manuscript and have agreed to the final content.

Competing interests

The authors declare no competing interests.

Grant information

Andrea Ballabeni and Carmen Sorrentino were funded by Cariplo Foundation (grant #, 2015.0081).

notes

¹Data were collected as part of a study involving bioscientists working in four geographical locations—Los Angeles-San Diego (CA-USA), London-Cambridge (UK), Milan (Italy), and New York City (NY-USA). For a list of the institutions where the invited scientists work, see, Carmen Sorrentino *et al.*, *Increasing Both the Public Health Potential of Basic Research and the Scientist Satisfaction. An International Survey of Bio-Scientists [Version 2; Referees: 2 Approved]* (5, 2016).

²In this paper, we analyze the qualitative data collected using the *Comments* field (see FINAL REPORT). The overall results of the survey are published separately. See *ibid*.

³The survey can be accessed at https://f1000researchdata.s3.amazonaws.com/datasets/7683/e2cce3ea-006d-4143-befe-10b5dd86c3e2_Data.zip.

⁴The Harvard T.H. Chan School of Public Health IRB (IRB15-2787) and the FIRC Institute of Molecular Oncology Ethics Committee reviewed and approved the study.

⁵For the overall results of the survey are published separately. See, Sorrentino *et al.*, *Increasing Both the Public Health Potential of Basic Research and the Scientist Satisfaction. An International Survey of Bio-Scientists [Version 2; Referees: 2 Approved]*.

⁶This is the last three digits of a random number assigned by the software at the time of data collection. We used them as unique and anonymous identifiers of participants.

⁷Please see Question 15 of the survey: Please evaluate the following policy: “Locate more basic research laboratories inside or in close proximity of hospitals”

Supplementary material

Supplementary File 1: First-step coding schema. Theme; issue; *sub-issue*.

[Click here to access the data.](#)

References

- Ajzen I: **The theory of planned behavior.** *Organ Behav Hum Dec.* 1991; **50**(2): 179–211.
[Publisher Full Text](#)
- Alberts B, Kirschner MW, Tilghman S, *et al.*: **Rescuing US biomedical research from its systemic flaws.** *Proc Natl Acad Sci U S A.* 2014; **111**(16): 5773–77.
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
- Alberts B, Kirschner MW, Tilghman S, *et al.*: **Opinion: Addressing systemic problems in the biomedical research enterprise.** *Proc Natl Acad Sci U S A.* 2015; **112**(7): 1912–13.
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
- Aykurt B: **Surveying Nanoscientists' Communication Activities and Online Behavior.** (Center for Science Studies, University of Aarhus), 2016.
[Reference Source](#)
- Besley JC, Oh SH, Nisbet M: **Predicting scientists' participation in public life.** *Public Underst Sci.* 2013; **22**(8): 971–87.
[PubMed Abstract](#) | [Publisher Full Text](#)
- Boggio A, Ballabeni A, Hemenway D: **Basic Research and Knowledge Production Modes: A View from the Harvard Medical School.** *Sci Technol Human Values.* 2016; **41**(2): 163–93.
[Publisher Full Text](#)
- Bozeman B: **Public values and public interest: counterbalancing economic individualism.** (Public management and change series; Washington, D.C.: Georgetown University Press) ix, 2007; 214.
[Reference Source](#)
- Bozeman B, Sarewitz D: **Public value mapping and science policy evaluation.** *Minerva.* 2011; **49**(1): 1–23.
[Publisher Full Text](#)
- Bruin de Bruin W, Bostrom A: **Assessing what to address in science communication.** *Proc Natl Acad Sci U S A.* 2013; **110**(Suppl 3): 14062–68.
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
- Bucchi M: **Science and the media alternative routes in scientific communication.** 1998.
[Reference Source](#)
- Burns TW, O'Connor DJ, Stocklmayer SM: **Science communication: a contemporary definition.** *Public Underst Sci.* 2003; **12**(2): 183–202.
[Publisher Full Text](#)
- Corrado M, Pooni K, Hartfree Y: **The Role of Scientists in Public Debate: Full Report.** (London: The Wellcome Trust), 2001.
[Reference Source](#)
- Daniels RJ: **A generation at risk: young investigators and the future of the biomedical workforce.** *Proc Natl Acad Sci U S A.* 2015; **112**(2): 313–18.
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
- Dudo A, Besley JC: **Scientists' Prioritization of Communication Objectives for Public Engagement.** *PLoS One.* 2016; **11**(2): e0148867.
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
- Dudo A, Kahlor L, AbiGhannam N, *et al.*: **An analysis of nanoscientists as public communicators.** *Nat Nanotechnol.* 2014; **9**(10): 841–44.
[PubMed Abstract](#) | [Publisher Full Text](#)
- Gascoigne T, Metcalfe J: **Incentives and impediments to scientists communicating through the media.** *Sci Commun.* 1997; **18**(3): 265–82.
[Publisher Full Text](#)
- Hilgartner S: **The Dominant View of Popularization: Conceptual Problems, Political Uses.** *Soc Stud Sci.* 1990; **20**(3): 519–39.
[Publisher Full Text](#)
- Kirchhoff CJ, Lemos MC, Dessai S: **Actionable knowledge for environmental decision making: broadening the usability of climate science.** *Annu Rev Environ Resour.* 2013; **38**(1): 393–414.
[Publisher Full Text](#)
- Martinson BC, Crain AL, Anderson MS, *et al.*: **Institutions' expectations for researchers' self-funding, federal grant holding, and private industry involvement: manifold drivers of self-interest and researcher behavior.** *Acad Med.* 2009; **84**(11): 1491–99.
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
- McDowell GS, Gunsalus KT, MacKellar DC, *et al.*: **Shaping the Future of Research: a perspective from junior scientists [version 2; referees: 2 approved].** *F1000Res.* 2014; **3**: 291.
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
- Pielke R Jr: **Basic research as a political symbol.** *Minerva.* 2012; **50**(3): 339–61.
[Publisher Full Text](#)
- Poliakoff E, Webb TL: **What factors predict scientists' intentions to participate in public engagement of science activities?** *Sci Commun.* 2007; **29**(2): 242–63.
[Publisher Full Text](#)
- Rödger S, Franzen M, Weingart P: **The Sciences' Media Connection –Public Communication and its Repercussions.** (Springer Netherlands), 2012; 28.
[Publisher Full Text](#)
- Sarewitz D, Pielke RA Jr: **The neglected heart of science policy: reconciling supply of and demand for science.** *Environ Sci Policy.* 2007; **10**(1): 5–16.
[Publisher Full Text](#)
- Scita G, Sorrentino C, Boggio A, *et al.*: **Dataset 1 in: Increasing the public health potential of basic research and the scientist satisfaction. An international survey of bioscientists.** *F1000Research.* 2016a.
[Data Source](#)
- Scita G, Sorrentino C, Boggio A, *et al.*: **Increasing the public health potential of basic research and the scientist satisfaction. An international survey of bioscientists [version 1; referees: 1 approved, 1 approved with reservations].** *F1000Res.* 2016b; **5**: 56.
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
- Siler K, Lee K, Bero L: **Measuring the effectiveness of scientific gatekeeping.** *Proc Natl Acad Sci U S A.* 2015; **112**(2): 360–65.
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
- Suldivsky B: **In science communication, why does the idea of the public deficit always return? Exploring key influences.** *Public Underst Sci.* 2016; **25**(4): 415–26.
[PubMed Abstract](#) | [Publisher Full Text](#)
- Vale RD: **Accelerating scientific publication in biology.** *Proc Natl Acad Sci U S A.* 2015; **112**(44): 13439–46.
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)

Peer review discontinued

At the request of the author(s), this article is no longer under peer review. What does this mean?

Version 1

Reviewer Report 09 March 2017

<https://doi.org/10.5256/f1000research.11691.r20839>

© 2017 Curtis V. This is an open access peer review report distributed under the terms of the [Creative Commons Attribution License](#), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Vickie Curtis

Wellcome Centre for Molecular Parasitology, University of Glasgow, Glasgow, UK

This paper utilizes the results of a previous survey that explores opinions relating to funding and policy among a group of biomedical scientists in the US, the UK and Italy. The authors have used a section in the questionnaire that asks for further comments to isolate views relating to 'science communication'. Conclusions are drawn about the attitudes of those surveyed toward science communication and public engagement more generally.

Unfortunately, there are some serious methodological problems with this work. The original purpose of the survey (which I have read, including all the feedback) was to explore views relating to funding and public policy issues directly affecting the basic research in the biomedical sciences. There were no questions that asked specifically about science communication or public engagement. The feedback analysed by the authors was obtained from a final section that asked for comments as follows:

Do you have ideas about other policies that can increase both the societal benefit potential of basic research and the scientist satisfaction, without affecting the fundamental nature of basic investigation? You can use this space to tell us about them or for any additional considerations related to the themes of this survey.

Again, this is not directly related to public engagement although a small proportion of the statements made by 145 of the respondents do contain some general statements relating to science communication media coverage of science, communication with clinicians and patient's groups and formal science education in schools. It is possible for new insights to be gained from work exploring a different research question. However, after reading the entirety of the feedback it is evident that much of the individual feedback has been taken out of context, and that the substance and meaning of the data has been greatly overstated. The statements made don't feel like they have been made to communicate views about PE, but have been made within the context of wider funding and policy issues that the survey was designed to address. I can't help feeling that the authors are squeezing this data for something substantive, when there isn't really much there – certainly not enough to draw some of the conclusions that they have made.

Sweeping statements are made about the views of bioscientists toward public engagement, and

statements such as 'many believe...' simply cannot be backed up by the sparse data. The authors need to be more specific and open about their dataset. Actual numbers need to be given (e.g. 10 respondents expressed this view etc...). It's not enough to generalise or to extrapolate this feedback to bioscientists in general – this is a very diverse body of scientists.

The authors need to give more detail about their methods of analysis. What specific approaches were taken? Did they undertake a thematic analysis. Use grounded theory? Some supporting references are needed here to signpost their approach to qualitative analysis for the reader. It is good that they attached their coding scheme, but some explanation of each theme would have been helpful. Also, I would like to know who coded the data. Was it coded by more than one individual? How was the reliability of the coding ascertained? Did they account for inter-coder reliability. If only one person coded the data – was this checked by someone else. Again, values for inter-coder reliability, or even an acknowledgement that this needs to be addressed in qualitative analysis would have been welcome.

The use of the theory of planned behaviour as a framework for analysis is questionable. At no point are scientists questioned about their intent to take part in public engagement activities. Looking at the raw data, there is nothing that stands out as an expression of intent. It is unclear why this framework has been applied to the data.

In addition to methodological problems, there are some other concerns about the contextualisation of the data within current work on public engagement. The authors appear to have focused on 'science communication' yet have used the terms 'outreach' and 'public engagement' interchangeably. The first paragraph of the paper gives a definition of science communication from 2003 that appears to encapsulate a rather one-way movement of information from informed scientists to uninformed public. This is quite different to more recent definitions of public engagement, which reflect a move from a deficit model of communication, to one that is based on dialogue and a greater understanding of the social and cultural context of communication.

By presenting this definition of science communication in the opening paragraph, I am unsure whether the authors are aware of the cultural shifts taking place in the public engagement landscape. The use of the term 'outreach' is also problematic. Outreach can (but not always) refer specifically to public engagement work in a school setting, often with the goal of increasing diversity in those who choose to study science at a tertiary level. While it is true that terminology in the public engagement literature can be confusing, there has been some work on this, and I would encourage the authors think about what public engagement means to them and also how the scientists they survey define it. Some of the references cited are a little out of date and much work has been done on public engagement and the greater emphasis on dialogic approaches. This work needs to be consulted to address this underlying issue which detracts greatly from the work.

There are other issues which need attention.

On several occasions, the authors make reference to the 'social value' of research without defining what that means, or how it can be measured. I am not sure how this relates to public engagement or the views expressed in the survey.

Using the terms 'scientists' and 'non-scientist' is problematic. For example, the authors refer to clinicians as being non-scientists. It is likely that many clinicians would disagree with that assessment. It may be more helpful to talk about 'specialists' and 'non-specialists'. This allows for the fact that some groups who aren't professional scientists, can be specialists in a given area. For example, patient groups. Also, scientists have different specialisations, so may not understand another discipline any better than someone who isn't a professional scientist.

The geographical categories don't make sense. Why not just divide them into country groups? I am assuming N/A in Table 1 means these scientists come from somewhere else – where? Is geographical origin relevant – there is no evidence that this has been considered in the analysis.

Despite the above criticisms, the authors allude to an interesting question about public engagement and basic research which could be addressed in more detail in a new study. Are views about public engagement related to whether a scientist carries out basic science or applied science? Given their previous contact with a substantial pool of scientists, the authors could re-design a more rigorous study. They could question scientists about the public engagement work they have actually carried out (rather than their intention) and explore whether activities and views were related to the kind of research that was carried out – bearing in mind that there are many other factors that influence public engagement activity. As a public engagement professional working with scientists in basic research, such a study would be of great interest.

As it stands, this study has too many methodological and theoretical flaws to be indexed. The body of data is insubstantial and the analysis is problematic. Too many sweeping generalisations are made which simply are not supported by the data. Within the work however, is the kernel of an interesting research question about public engagement within applied vs. basic research. I would urge the authors to consider this question and design a new study that can address this, paying attention to adequate data collection and a rigorous analysis. The following references may be helpful.

References

1. Burchell K, Sheppard C, Chambers J: A 'work in progress': UK researchers and participation in public engagement. *Research for All*. 2017; **1** (1): 198-224 [Publisher Full Text](#)
2. Devonshire IM, Hathway GJ: Overcoming the barriers to greater public engagement. *PLoS Biol*. 2014; **12** (1): e1001761 [PubMed Abstract](#) | [Publisher Full Text](#)
3. Bauer M, Allum N, Miller S: What can we learn from 25 years of PUS survey research? Liberating and expanding the agenda. *Public Understanding of Science*. 2007; **16** (1): 79-95 [Publisher Full Text](#)
4. Marris C, Rose N: Open Engagement: Exploring Public Participation in the Biosciences. *PLoS Biology*. 2010; **8** (11). [Publisher Full Text](#)
5. Stilgoe J, Lock SJ, Wilsdon J: Why should we promote public engagement with science?. *Public Underst Sci*. 2014; **23** (1): 4-15 [PubMed Abstract](#) | [Publisher Full Text](#)
6. Grand A, Davies G, Holliman R, Adams A: Mapping public engagement with research in a UK University. *PLoS One*. 2015; **10** (4): e0121874 [PubMed Abstract](#) | [Publisher Full Text](#)
7. Braun V, Clarke V: Using thematic analysis in psychology. *Qualitative Research in Psychology*. 2006; **3** (2): 77-101 [Publisher Full Text](#)
8. Bryman A: Integrating quantitative and qualitative research: how is it done?. *Qualitative Research*. 2006; **6** (1): 97-113 [Publisher Full Text](#)
9. Bayerl P, Paul K: What Determines Inter-Coder Agreement in Manual Annotations? A Meta-Analytic Investigation. *Computational Linguistics*. 2011; **37** (4): 699-725 [Publisher Full Text](#)

10. Onwuegbuzie A, Leech N: On Becoming a Pragmatic Researcher: The Importance of Combining Quantitative and Qualitative Research Methodologies. *International Journal of Social Research Methodology*. 2005; **8** (5): 375-387 [Publisher Full Text](#)
11. Rolfe G: Validity, trustworthiness and rigour: quality and the idea of qualitative research. *J Adv Nurs*. 2006; **53** (3): 304-10 [PubMed Abstract](#) | [Publisher Full Text](#)

Competing Interests: No competing interests were disclosed.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to state that I do not consider it to be of an acceptable scientific standard, for reasons outlined above.

Author Response 22 Jun 2017

Andrea Boggio, Bryant University, Smithfield, USA

We want to thank Dr. Curtis for her insightful review. Her points are well taken and the reference list that is appended is also a useful and thoughtful resource that would help us strengthen the research. We certainly appreciate her encouragement to pursue some of the questions we raise in the paper. This would entail designing a new study. Unfortunately, at the moment, we lack the resources to design and conduct such study. For this reason, we have decided not further develop the ideas proposed in the review.

Competing Interests: No competing interests were disclosed.

The benefits of publishing with F1000Research:

- Your article is published within days, with no editorial bias
- You can publish traditional articles, null/negative results, case reports, data notes and more
- The peer review process is transparent and collaborative
- Your article is indexed in PubMed after passing peer review
- Dedicated customer support at every stage

For pre-submission enquiries, contact research@f1000.com

F1000Research