Research Article

Qualitative Interviews With Science Communication Trainers About Communication Objectives and Goals

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Abstract

Qualitative interviews with science communication trainers (n = 24) on the role of objectives and goals in training efforts suggest that trainers believe that scientists come to training with a range of long-term goals in mind. However, trainers appear to focus on teaching communication skills and are relatively unlikely to focus on identifying specific communication objectives as a means of achieving scientists' goals. The communication objective that trainers consistently report emphasizing is knowledge building. Other potential objectives such as fostering excitement, building trust, and reframing issues were rarely raised. Research aimed at helping trainers foster strategic communication capacity is proposed.

Keywords

qualitative interviews, scientists' perception of the public, training, goals, objectives

The current study seeks to better understand how science communication trainers think about communication objectives and goals. Underlying the

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focus is a question about whether current science communication training focuses too much on building technical skills and inadequately attends to the strategic selection of specific communication objectives (e.g., building trust) that theory and evidence suggest might help achieve scientists' long-term communication goals (e.g., support for policy). This could mean, for example, that current science communication training may be helping scientists become technically skilled at communicating in ways that have little potential impact. Science communication researchers' long-standing lament that scientists need to focus on more than trying to address citizens' knowledge deficits (Bauer, Allum, & Miller, 2007; Fischhoff, 1995) should be understood, in this regard, as a critique of the overemphasis of an objective (e.g., science literacy) that evidence suggests may not result in achieving scientists' actual goals. Furthermore, this overemphasis should be understood as a failure by science communicators to set appropriate strategic objectives and goals as the critical first stage in any effort to communicate effectively. Indeed, the very idea of "effective" communication is contingent on setting intermediate objectives and ultimate goals against which such communication can be assessed (Hon, 1998).

The current study focuses on science communication training because such efforts represent a central way through which the insights of communication research can be made available to scientists serving as communicators (Miller, Fahy, & The ESConet Team, 2009; Trench & Miller, 2012). Such training, however, does not appear to have been the focus of substantial past research. Below, we provide a review of the main literature that underlies the study. Although the current article is critical of current communication training efforts, it fully recognizes that many scientists have received excellent training from dedicated trainers. Indeed, this research comes out of collaboration with the training community and a desire to better connect research with training.

Literature Review

Research on Science Communication Training and Scientists as Communicators

In the current study, our definition of science communication training is purposefully broad. We define it as any activity wherein someone from the scientific community—often a natural scientist with no formal communication background—receives sustained guidance on how to communicate effectively or is provided with the opportunity to engage in a structured practice communicating about science (typically both). "Public engagement" training

would be considered communication training in the current context given that much of current science communication scholarship emphasizes the value of creating opportunities for dialogue between scientists and their broader communities (Nisbet & Scheufele, 2009). The current study would not, however, include training taken as course work in a degree program or informal advice given from one colleague to another. Exemplars of science communication training programs include efforts of the Alan Alda Center for Communicating Science (http://www.centerforcommunicatingscience.org/), the Banff Center (2015), the Center for Public Engagement with Science & Technology at the American Association for the Advancement of Science (AAAS; 2015), and COMPASS (Smith et al., 2013). Most of the trainers interviewed below provide courses of a half-day up to a full week or more. In some cases, these trainings might be split over multiple sessions.

Past work on science communication training has generally focused on the effect of the training on communication practice. Studies have, for example, addressed questions such as the efficacy of training programs (Miller et al., 2009) and the spread and character of programs (Trench & Miller, 2012). Other work has looked at questions such as what science communication researchers feel like scientists need from training (Besley & Tanner, 2011) or attempted to develop tools to support training efforts (Baram-Tsabari & Lewenstein, 2013). To our knowledge, few studies focused primarily on science communication trainers' views of training programs have been published apart from several studies exploring the experiences of trainers in Europe (e.g., Miller et al., 2009; Trench & Miller, 2012).

While research on science communication training appears rare, one related body of research has found that scientists continue to think about communication in relatively simplistic or problematic ways. This work focuses on scientists' attitudes toward engagement and includes a range of qualitative (e.g., Blok, Jensen, & Kaltoft, 2008; Davies, 2008; Maranta, Guggenheim, Gisler, & Pohl, 2003) and quantitative research (Besley, 2015; Besley, Oh, & Nisbet, 2013; Dudo, Kahlor, AbiGhannam, Lazard, & Liang, 2014; Dunwoody, Brossard, & Dudo, 2009; Kahlor, Dudo, Liang, & AbiGhannam, 2015; Peters et al., 2008). A summary of initial work in this area concluded that scientists have relatively negative opinions about the public and journalists. Yet, despite the fact that scientists see limited benefits to engagement, they see a great need to have a role in public decision making (Besley & Nisbet, 2013). Follow-up studies suggested that there was little relationship between how scientists see the public and their views about engagement practice (Besley, 2015; Besley et al., 2013). For the current study, what is important is that past research has largely focused on what scientists think about engagement and what might lead scientists to

engage—not what they are trying to achieve through engagement (Salmon, Priestley, & Goven, 2015).

Scientists' Communication Objectives and Goals: Guidance From Public Relations

As noted above, scant empirical evidence grapples with what specific objectives scientists are trying to accomplish through their public engagement efforts. What is clear, however, is the existence of a widespread belief among the scientific community that increasing public knowledge about science enhances public support of science—a belief often called the "deficit model" (Bauer et al., 2007; Besley & Nisbet, 2013; Fischhoff, 1995). Enhancing public knowledge about science, according to this view, leads to a range of attitudes and behaviors that ultimately enhance the scientific enterprise (Logan, 2001). This assumption, however, has faced widespread criticism, as evidence continues to show that the influence of scientific knowledge on attitudes toward scientific issues is modest (Allum, Sturgis, Tabourazi, & Brunton-Smith, 2008) and that other factors (e.g., ideological predispositions) are necessary to consider when it comes to understanding how individuals perceive science (e.g., Kahan, Braman, Slovic, Gastil, & Cohen, 2009; Ho, Brossard, & Scheufele, 2008). For the purposes of this study, the limits of spreading knowledge as a communication objective implies that a scientist may want to develop a more diversified approach when it comes to how they think about and identify what they seek to achieve in their public communication efforts. Insights about the impetus and nature of this diversification can be found within public relations scholarship.

Two-Way Communication. Grunig and Hunt's (1984) excellence theory highlights the importance of two-way communication between stakeholders. Interested in identifying excellent organizational communication, the theory explained the factors that might allow strategic communication to function as a boundary spanner between organizations and publics. The authors delineated different models of strategic communication, juxtaposing asymmetrical communication (i.e., one-way, linear communication directed from organizations to its publics) with symmetrical communication (i.e., bidirectional communication wherein organizations encourage key publics to voice their opinions to resolve conflict and/or to promote mutual understanding; Grunig & Grunig, 1989, 1998) . This focus on two-way symmetrical communication emphasized the importance of promoting meaningful dialogue as a key way to improve relationships between communication participants (Hon & Grunig, 1999) and has become a recognized as a fundamental feature of

high-quality communication within public relations and other fields, including political science (Delli, Carpini, Cook, & Jacobs, 2004).

In the context of this study, two-way communication represents an important starting point for improving science communication inasmuch as it can help replace the traditional top-down information transmission model with one that centers on fostering genuine dialogue and mutual understanding (McCallie et al., 2009). However, two-way communication does not seem to be a stand-alone objective. Rather, as we discuss below, it should probably be considered as a model or tactic that science communicators could use to realize the objectives and goals they hope to achieve.

Strategic Communication. Scholarship focused on *public relations roles* could also help efforts to diversify how scientists approach outreach. Building on work in organizational theory (Broom & Smith, 1979; Katz & Kahn, 1978) , Broom and Dozier (1986) found that public relations professionals fulfill two primary roles: "manager" or "technician." Communication "technicians," they found, are primarily focused on producing communication materials (e.g., providing technical communication services, such as crafting and placing messages). Conversely, they found that communication "managers" fulfilled the role of experts who engage in "activities that involve expert prescription, communication facilitation, and problem-solving process facilitation" (Broom & Dozier, 1986, p. 41). They contended that good technical communication is insufficient when it comes to doing effective communication, and noted that effective communication requires the context, strategic perspective, and goal orientation inherent in the manager role (Dozier & Broom, 1995). Their work, similar to the work that emerged from excellence theory, has been widely replicated and is ingrained within the public relations community (van Ruler, 2004). For this study, it implies that communication training focused primarily on boosting scientists' technical communication skills is inadequate. While developing these technical skills may indeed be an important part of training programs, empowering scientists to achieve more meaningful communication outcomes requires that they are also trained to understand and embody the more sophisticated strategic habits of mind associated with communication managers.

Objective- and Goal-Oriented Communication. An initial—and key—step in the aforementioned type of strategic thinking is placing a focus on the effectiveness of communication. This focus on communication effectiveness stems from work that found a propensity among communication programs to operate on a "domino" assumption, blindly (and incorrectly) assuming that their messages would affect knowledge, attitudes, and behaviors among target

audiences in desirable and demonstrable ways (Dozier & Ehling, 1992). The faultiness of this assumption was exposed within strategic communication as clients began to demand clearer return on investment, and public relations now considers "effective" communication to be that which achieves meaningful, measurable outcomes (Holmes, 1996). More specifically, scholars in strategic communication now emphasize the importance of communication that is guided by, and seeks to meet, specific objectives and goals (Hon, 1998). Communication objectives and goals are thought of as complementary but different, whereas goals are seen as being the longer term desired outcomes of communication plans or campaigns (Kendall, 1996), objectives are regarded as being the shorter term specific outcomes sought en route to achieving the broader goal (Hon, 1998; Kendall, 1996). In this regard, science communication efforts should be directed by specific intended outcomes for the scientist communicators, the institutions they may represent, and the individuals with whom they engage.

Objectives and Goals for the Public Communication of Science. As mentioned above, the scientific community's approach to public communication has often been primarily focused on disseminating information and building public knowledge about science (Bauer et al., 2007; Besley & Nisbet, 2013; Fischhoff, 1995). While calls for more frequent interaction between scientists and public audiences are not new (e.g., Bodmer, 1985; The Royal Society, 1985), leaders of the scientific community are increasingly vocal when it comes to improving public communication of science (e.g., Cicerone, 2010; Leshner, 2006, 2015; Napolitano, 2015) . Presently, leading organizations in the United States such as the National Academy of Sciences (2012, 2013) and the AAAS have both (e.g., Pinholster, 2015) emphasized improving the quality of science communication practice.

Science communication training has become one key way that organizations such as the AAAS are trying to achieve such improvements. While the availability and proliferation of these programs are laudable, it is important to consider the nature and intent of their curriculums. Doing so would, in part, help reveal the extent to which these programs are diversifying scientists' approach to public communication. In the current study, we are particularly interested in the degree to which training programs are embracing the previously described tenets of public relations. We place a special emphasis on exploring the degree to which the programs focus on building scientists' ability to consider a broader array of specific effects (hereafter, intermediate "objectives") that they can seek, as well as the relationship between these objectives and the ultimate outcomes (hereafter, long-term "goals") that they might ultimately hope to achieve. The current study is therefore premised on

the idea that science communication training should involve helping scientists identify realistic, long-term goals and then helping those scientists identify intermediate objectives that evidence suggests might be associated with those goals. Communicative behavior would then be targeted at achieving these objectives. As such, we sought to better understand scientists' intermediate objectives and long-term goals for public engagement. Our analyses were therefore guided by the following research questions:

RQ1: Where do trainers think scientists' communication goals originate?
RQ2: What types of long-term goals—both internal and external—do trainers think scientists want help achieving?
RQ3: To what extent are intermediate objectives being discussed during science communication training?
RQ4: What connection do trainers make between skills training, objectives, and goal-setting?

The proposal of research questions reflects the fact that as a qualitative study, the research was not specifically seeking to test a theory about why science communication trainers do what they do. The research was instead aimed at getting a baseline description of how trainers think about training efforts, and the extent to which their approach embodies the fundamental principles from strategic communication research outlined earlier—particularly the relative emphasis placed on skills and strategy, and the presence and types of communication objectives and goals. We did not undertake the interviews with an exhaustive a priori list of specific objectives and goals for public science communication. Instead, we first asked the trainers what types of objectives and goals that they thought scientists had for their communication efforts and followed up by asking about a specific subset of objectives to help stimulate further discussion. In this regard, our approach was primarily inductive and only moderately deductive. The next section provides more details about the interview procedure, including the objectives about which trainers were asked.

Method

Sampling

The research team used (1) an initial list of trainers compiled by the training organization COMPASS (Neeley & Goldman, 2013), (2) dialogue with the AAAS's Center for Public Engagement with Science & Technology (which plays an informal coordinating role for public engagement efforts across the

broader professional scientific community), (3) snowball sampling (i.e., respondents were asked to identify other potential interview subjects with experience in science communication training; Hocking, Stacks, & McDermott, 2003), and (4) targeted Internet searching to compile a list of individuals involved in science communication training in the United States and Canada. Almost all potential respondents—including all of the larger training organizations—were identified by the first three approaches. Ultimately, the sampling process reassured the authors that they had developed a strong sense of the community of people who were doing regular, ongoing science communication training in North America.

Once individuals who conducted training or were heavily involved in the design of training were identified (hereafter, trainers), we sent them an e-mail describing the project and invited them to participate in an interview. Up to two follow-up e-mails and a phone call were made to solicit participation from those who did not respond. In situations where a single organization had multiple people conducting training, only one or two trainers were contacted. An additional effort was made to identify science communication trainers working with traditionally underrepresented groups by contacting scientific societies associated with those groups, but this did not result in the identification of any additional trainers not already identified. Ultimately, 51 trainers were e-mailed. Of these, 26 responded, and interviews were completed with 24 people involved in science communication training. We were not able to find a suitable time to interview the remaining two trainers.

The authors jointly determined that they were not hearing additional substantial information after 24 interviews and that it was not useful to further seek out trainers who had not yet responded. This decision was consistent with standards in qualitative research relative to conducting and coding in-depth interviews. Specifically, investigators are encouraged to determine their sample size inductively based on their careful, collective judgment as to when no new information is emerging from the interviews (i.e., data saturation; for more information, see Guest, Bunce, & Johnson, 2012; Miles & Huberman, 1994; Morse, 1995) .

The average age of the interviewed trainers was 45 years (SD = 13), and there were more female (n = 16) than male trainers (n = 8). Most interviewees reported being White (n = 22), with one interviewee indicating ethnicity as Asian/Indian and one as African American. One respondent further indicated being Hispanic. Most interviewees had completed a graduate school degree (n = 19), and they were almost evenly split in terms of scientific discipline (e.g., 13 interviewees identified themselves as natural scientists, 9 as social scientists, and 2 as both). Additional information about the participants' background can be requested from the authors.

Interview Procedures

Before participating, trainers were asked to consent and provide background information through an online questionnaire. Three interviewers developed a semistructured interview protocol and conducted individual telephone interviews. The protocol initially asked trainers what types of goals they thought scientists had for their communication efforts and then asked the degree to which the training they provided emphasized general skills versus how to achieve specific objectives and goals. Trainers were then queried about a specific subset of potential communication objectives including the degree to which the training they provide focused on building knowledge; fostering excitement (e.g., National Research Council, 2009); building trust by showing caring, listening, and/or competence (e.g., Fiske & Dupree, 2014); and framing messages so that they resonate with audiences (e.g., Nisbet, 2010). These objectives were selected based on their prominence in the science communication literature (for a review, see Besley, Dudo, & Storksdieck, 2015) but are not meant to be an exhaustive list of objectives. We recognize that additional or alternative objectives might have been selected. Trainers were then asked about whether these objectives were discussed in their training and the degree to which they felt that scientists were comfortable with these objectives. Trainers were also asked if there were other objectives, not raised, that they emphasized.

The first author conducted 11 interviews, the second author conducted 10 interviews, and the third author conducted 3 interviews. Multiple interviewers were used because of a desire to ensure that the researchers involved in the project had an opportunity to hear directly from trainers. Telephone interviews were used because the trainers are located around North America. All the interviews were recorded, transcribed immediately, and shared with the other interviewers. Postinterview notes focused on impressions formed during the interviews were also shared. Initial test interviews were conducted with three trainers who were already familiar with the project and who knew the first and second authors. Feedback was also obtained from an expert advisory board associated with the project. The average interview took 42 minutes to complete, with the range spanning from 20 minutes to 70 minutes. All interviews were conducted between September 19, 2014, and November 14, 2014.

Coding

Thematic analysis using NVivo software was used to identify a meaningful set of key themes within a corpus of interviews (Guest, MacQueen, & Namey, 2012). The first author iteratively developed a coding schema based on the

literature, his reading of the interviews, as well as discussions with the other authors. Consequently, interviews were analyzed using a deductive and inductive qualitative approach. Because the current research drew on several bodies of existing theory in its design, we used theory to guide the coding and analysis processes. We also derived concepts and relationships that emerged from the data themselves and that were not covered in existing theories, thus using a quasi–grounded theory approach (Strauss & Corbin, 1998). Ultimately, the key themes discussed below (Table 1) were relatively consistent with the question areas from the interview protocol. The analysis here focuses on the portion of the interviews that explored the degree to which trainers focused their training efforts on providing scientists with specific skills and the section focused on setting goals and objectives. It also includes the section of the interview where trainers were asked about a set of specific objectives.

Results

In general, communication trainers indicated that the scientists they work with have a range of long-term goals and that the training they provide emphasizes communication skills development. Training did not appear to focus on helping scientists prioritize objectives or strategize about how these objectives might be achieved. Nevertheless, it is also clear that many of the skills that trainers emphasize might result in achieving a range of communication objectives, even if the connections are not made explicit during training. Below, we first describe the perceived origins (RQ1) and nature (RQ2) of scientists' long-term goals for public engagement. We then turn to their views about several intermediate communication-oriented objectives that a strategic communicator might emphasize to achieve their long-term goals (RQ3). The last section discusses the connections between objectives and skills (RQ4).

Origin of Scientists' Communication Goals (RQ1)

The trainers interviewed almost all indicated that they encouraged scientists to *set their own goal*s. This position was stated early in the interview process and did not appear to vary substantially:

> I want them to be thinking about this question of are they being critical or are they being advocate? Are they being message-oriented? But basically I'm giving them skills that they can use no matter what their goal is. (Interview 1)

Often, there was a recognition that the goals scientists might have would change depending on the audience they had access to (e.g., Interview 19) and

Table 1. Summary of Long-Term Communication Goals Identified in Interviews With Science Communication Trainers and Responses to Questions About Objectives and Skills.

Code	Description of the code
Origin of goals	
Personal benefits	Responses emphasizing that scientists set their own goals for communication activities, rather than relying on others for guidance
Communication goals	
Internal	
Personal benefits	Responses emphasizing that being a better communicator could benefit one's career in terms of research and teaching
Societal benefits	Responses emphasizing the enjoyment scientists derive from engaging on prosocial issues
Be better	Responses noting that communication training can decrease discomfort or increase comfort when in a communication role
External	
General value of science	Responses addressing a need to ensure that science is well regarded by decision makers and the broader public, especially regarding funding
Specific value of science	Responses addressing a need to have the public consider specific types of evidence that might motivate changes in current policies
Sense of duty	Responses noting that communication is needed because society funds scientists' research
Role model	Responses noting a desire to ensure that there are appropriate role models in society
Communication objectives	
Increase knowledge	Responses addressing science education and increasing public knowledge/awareness about science or specific facts/issues
Fostering excitement	Responses focused on enhancing interest or excitement
Building trust	Responses focused on boosting trust, including listening, respectful/warm behavior, and competence
Framing issues	Responses focused on (re)framing scientific issues in ways that improve accessibility and resonance
Communication skills	
Brief and clear	Responses focused on the need for clear, concise communication
Know your audience	Responses focused on the value of understanding an audience, including its prior knowledge and/or worldviews
Nonverbal	Responses noting the value of effective nonverbal communication, such as posture or tone
Storytelling	Responses addressing the value of using narrative formats in science communication

what that audience might be hoping to get from interacting with a scientist (e.g., Interview 20). It important to note that when trainers talked about scientists' goal selection, it was clear they were also almost always talking about societal goals related to specific policy options rather than intermediate objectives that might help them achieve those ultimate goals.

Scientists' Long-Term Goals for Communicating (RQ2)

Trainers appear to split motivations for scientist communication into *internal* and *external* goals. *Internal* goals appear to include issues related to a scientist's desire to realize *personal benefits* and pursue larger *societal benefits* as part of her or his career. There were also several relatively general responses suggesting that trainers appeared to believe scientists sign up for training simply out of a desire to *be better* at communicating.

For *external* benefits, the central goals appear to be desire for government decision makers to make policy decisions that are consistent with scientific evidence. At the most general level, this was about ensuring recognition for the *general value of science* and the need to fund science programs. A number of trainers also emphasized the importance of recognizing the *specific value of science* in providing policy guidance on particular issues, such as environmental protection. Other *external* factors included a desire to communicate either out of a *sense of duty* to the society that funded the research or in recognition of the potential value of serving as a *role model*. Each of these long-term goal areas is discussed below.

Internal Goals for Engagement. The trainers mentioned a number of *personal benefits* that they felt the scientists they worked with were considering in the decision to engage and seek engagement training. Several trainers said that many young scientists simply see public engagement as an integral part of the scientific process. For example, one trainer said, "They [many young scientists] see that [outreach] as a natural part of the career; they don't see that as an add-on" (Interview 1). This could involve some element of peer pressure as scientists are seeing [their] peer groups "getting positive feedback out of their experiences" and observing a "little bit of a competitive spirit" relative to outreach (Interview 23). This viewpoint suggests that scientists need communication skills for the same reason they need statistical or conceptual knowledge.

Many trainers also emphasized pragmatic *personal benefits* of science communication skills. This includes the idea that better communication can lead to more funding along with positive recognition from other academics. For example, one trainer said, "[Scientists] know that funding is extremely competitive nowadays, and in order to get that funding, they need to be able

to explain to the public, to potential funders, to government officials, exactly what they do and why it's important" (Interview 11). Other trainers (e.g., Interviews 13, 15, 16) added potential employers to the list, with some noting that internal promotion might also depend on communication success (e.g., Interviews 14, 20). The potential for training to improve teaching performance was also mentioned in multiple interviews. A more pessimistic viewpoint came from a trainer who noted that some of the scientists he trains fear losing funding because of a failure to communicate in ways that address broader impacts (Interview 12).

Two additional *internal* benefits that arose in a few cases focused on the idea that some scientists simply enjoy interacting with people beyond the academy in order to achieve *societal benefits*, while others simply want to *be better* at communicating so that they are more comfortable when interacting with the public. These seem related inasmuch as both assume there is a need to engage; they differ in that one emphasizes the enjoyment that comes from prosocial acts while the other emphasizes removing discomfort. The idea that scientists who know they need to engage want to feel comfortable was raised by trainers who said things like "[The scientists we train] enjoy doing outreach or communicating their work, but they feel that often they haven't had the experience in improving their skill[s]" (Interview 9). Communication training, in this regard, appears to be seen as something that "can help them advance professionally, no matter where they are" (Interview 18).

External Goals for Engagement. Ensuring that their fellow citizens and policy makers recognize the *general value of science* was the most common public engagement goal the trainers associated with scientists. For example, one interviewee emphasized that public engagement is necessary to "the overall scientific literacy of our society" (Interview 11). Another trainer similarly pointed to the need to get Americans to support science.

> That if they are going to see science not only survive well into the future, but thrive, they are going to have to become articulate advocates for why science is important, why it matters and the value to essentially the shareholders, the American people who are funding it. (Interview 17)

The belief appears to be that science is good for society alongside a fear that not everyone sees the benefits. Scientists, it seems, feel they must play the role of science ambassador.

Another external goal highlighted from the interviews was the desire to ensure that a *specific value of science* is communicated to stakeholders. Trainers who emphasized this goal said they felt that scientists were seeing

evidence from their research or overall discipline that suggested that some type of policy (e.g., action on climate change) or behavior (e.g., vaccination) needed to occur (Interview 12). One trainer captured a sense of urgency and frustration that emerged across many of the interviews.

> [Our trainees] are compelled by the data, [and want to . . .] warn people about large scale, ecosystem changes, climate change, that kind of thing. And I think they are very sensitized to their sense of . . . a culture war where scientific information is being ignored or devalued largely in sort of the political sphere, but also public life. (Interview 5)

A number of trainers active around this type of long-term goal highlighted the challenge of helping scientists find effective channels through which they might make a difference.

One final external goal commonly identified by trainers was a desire to engage with the public out of a *sense of duty* to the society that funded their research or to serve as a *role model* in their community. The sense of duty to "the taxpayer" who is "paying" the bill (Interview 12), for example, was raised by multiple trainers. One called it "part of their social contract as a scientist, and part of their responsibility as a scientist" (Interview 18). One trainer talked about the role model aspect in terms of "giving back to the community" in situations where a lack of role models may be perceived (Interview 18). In both cases, the key idea is that some scientists likely feel that engagement is some sort of ethical or moral obligation.

Views About Communication Objectives (RQ3)

While trainers believe scientists have a range of overarching long-term goals for communication, the next set of questions posed in the interviews attempted to get at what the various training programs did in order to try to help scientists achieve those goals. Specifically, an effort was made to get the interviewees to indicate the degree to which their training emphasized specific intermediate, communication-oriented objectives that they might seek to achieve in order to realize the long-term goals described above.

The Objective of Increasing Knowledge. As might be expected, there was unanimity that scientists could, should, and would aim at *increasing knowledge* through public engagement. "That [is] sort of what brought them here in the first place," said one trainer (Interview 1). Another answered the question of comfort about the knowledge objective in a way that suggested that communication and education are synonymous.

> We don't really talk about it at all because it's implied [that] if they're signing up for a science communication class, we assume they're enthusiastic about communicating science. (Interview 6)

It was also clear that many trainers believed that scientists' logic was that by increasing knowledge, scientists could improve society (e.g., Interviews 13, 18). Several trainers argued that this was the most comfortable role for scientists because scientists all "came through grad schools . . . so they know what it is to be in the role of an educator" (Interview 11). The *increasing knowledge* objective often manifested in an emphasis the skills of ensuring clear, jargon-free communication or in an emphasis on helping scientists develop the skill to select key pieces of information that they felt laypersons need to know (Interview 6).

It was also clear, however, that many of the trainers recognized that the available evidence suggests that simply increasing knowledge was unlikely to have much effect. It is not clear in the interview transcripts how this recognition might shape training practice, but, for example, it might be associated with more emphasis on other objectives. For example, one trainer said that trainers try to move beyond informing to get at the questions of "how you would get people more involved? And then once they're involved, how would you get them more engaged?" (Interview 15). Some trainers also thought about knowledge in terms of correcting misinformation, rather than building new knowledge (Interview 6). It is not clear, however, whether this should be treated as part of increasing knowledge or as a separate objective in trainers' minds.

The Objective of Fostering Excitement. The trainers interviewed had mixed views about the degree to which the scientists they train would want them to prioritize *fostering excitement* as a communication objective. The majority of the trainers indicated that fostering excitement about science was not an explicit objective of their training. One trainer, for example, argued that many scientists simply "don't see themselves in that role" and said he felt that such communication approaches were best left to entertainers like Bill Nye (Interview 12). Trainers did not, however, suggest that trying to increase excitement or interest would be seen as unethical or undesirable—just that many scientists would be personally uncomfortable with the goal. When this objective did appear, it was through trainers encouraging scientists to let themselves express their own enthusiasm or passion (e.g., Interviews 10, 15) so as to circumvent being seen as dull (Interviews 13, 16).

One potential limitation in how trainers talked about excitement is that the discussion often implied that *fostering excitement* was required in order to get

people to pay attention to the content of what scientists are saying. For example, one trainer compared getting people interested with science "to rais[ing] appreciation and awareness" (Interview 2). The challenge here is that trainers often viewed excitement as part of the path toward *increasing knowledge* rather than as part of a pathway to long-term goals.

The Objective of Building Trust. Trainers were also mixed on the degree to which they felt that the scientists they train would be comfortable with *building trust* as an objective of communication. Several trainers also indicated that they did not think *building trust* was something that most scientists actively think about, particularly at the junior level (e.g., Interview 16). Only a few trainers said that trust building was an issue that they emphasize when working with scientists. Trust, in this regard, might include efforts to ensure that scientists are seen as warm and competent (Fiske & Dupree, 2014) and might include things such as making personal connections, demonstrating respect, and being willing to listen.

There was some recognition that actively trying to get someone to trust you might be "too much" like persuasion (Interview 11) or inappropriately emotion oriented (Interview 12). For example, one trainer said that the people trained are likely fine with "establishing yourself as a person who they can relate to" but are less comfortable with "picking and choosing tidbits to present in a way" that connects with others' values (Interview 8). Another trainer, however, noted that training could help scientists get more comfortable with this objective (Interview 1).

On the other hand, it also became clear during the interviews that many of the skills trainers teach might affect perceptions of scientists' warmth and/or competence. For example, on the warmth side, the trainers said they encourage things such as being accessible (Interview 6), revealing "a little more of yourself" (Interview 13), being authentic (Interview 17), showing that you are nice (Interview 21), and having a real, two-way conversation (Interview 9). Regarding competence, trainers' emphasis was on ensuring accuracy (Interview 13), being careful to substantiate assertions (Interviews 13 and 17), and being transparent (Interview 5). However, although trainers indicated that scientists would be fine with tactics to establish their expertise, this objective was not integral to training efforts. Furthermore, as with excitement, trainers appeared to see trust building as an additional mechanism for getting people to pay attention to scientists' factual information.

The Objective of Framing Issues. Many trainers said that most scientists see value with the objective of *framing issues* so that they resonate with audiences; however, several trainers also expressed potential concerns. A frame in this context should be understood as the interpretive story line running

through a communication that emphasizes a specific way of thinking about an issue (Nisbet, 2015). Trainers generally agreed that most scientists come to recognize why thoughtful framing of issues is important once they understand the concept. For example, one trainer noted the following:

> We try to make it clear that we're not advocating for . . . framing because . . . people sometimes react very negatively to that concept, that they feel like they're being told they should spin things and somehow immorally manipulate people into thinking a certain way. And we do try to explicitly combat that impression and talk about . . . presenting entirely true information and the question is just how you present it . . . with a particular audience. (Interview 8)

Getting to this level of understanding, however, can be difficult, according to several trainers. One trainer said that *framing issues* "is an advanced-level" objective seldom addressed during their courses (Interview 10). Another noted that views about framing have changed substantially.

> Scientists were really mad about that. And I don't find that to be the case at all anymore. You tell people, "Oh, we need to frame this. We need to put it in context." And people are like, "Oh yeah, of course we do." . . . [But] I remember . . . [when] it was just kind of like, "Holy smokes!" I mean, people were really insane. I mean, it was as if that was accusing scientists of lying or something. (Interview 20)

Overall, there appeared to be widespread recognition about the value in helping scientists see *framing issues* as a key objective. For example, one trainer talked about how he tries to work with scientists to connect with legislators' priorities (Interview 12). Others provided similar responses focused on how they work with scientists to make sure that what they say resonates with their specific audiences (e.g., Interviews 14, 17). However, in some cases, it also seemed that some trainers were thinking about *framing issues* only in terms of making things generally relevant, rather than choosing specific words or concepts that complement how someone thinks about an issue. For example, trainers said that framing is just another way of saying that you need to "know your audience" (Interview 18) or using "metaphors" appropriately (Interview 19).

The Relationship Between Skills and Communication Objectives (RQ4)

Of the four selected communication objectives noted above (*increasing knowledge, fostering excitement, building trust*, and *framing issues*), only *increasing knowledge* was regularly raised as an objective by trainers without

prompting. Indeed, trainers rarely raised other objectives independently, even when asked about additional objectives fcoused on in their training. Instead, the trainers indicated that the bulk of their efforts focused on teaching scientists the skills they might need to be effective communicators. The trainers, however, only rarely explicitly connected specific skills to communication objectives.

The most common skill the trainers raised was helping scientists be *brief and clear*. One of the trainers interviewed captured this idea, saying, "Probably the most important skill for a scientist, is learning to be straightforward and easy to comprehend (Interview 10)." This need often translated into efforts to highlight and remove jargon from speaking as well as tasks aimed at helping scientists select a subset of key messages that they hoped were most important. One trainer termed this "distilling the message" down to "its core" (Interview 22).

In general, it seemed that the trainers primarily thought about the value of being *brief and clear* in terms of its likely role in *increasing knowledge* and *fostering excitement* (in the form of interest). For example, one trainer noted,

> Messaging is our core tool that we teach . . . for whatever their intended audience is, how can they move clearly, articulate what do they know and why does it matter, and then what do they want that audience to do with that information . . . (Interview 5)

Thereappeared to be little suggestion that being *brief and clear* might also, for example, help in *building trust* by demonstrating concern for audiences needs or by avoiding the unnecessary creation of social distance.

Many trainers also focused on the skill of learning to *know your audience*. This skill could be said to be relevant to a range of communication objectives. It is relevant to *increasing knowledge* inasmuch as it may be important to adopt "different levels of complexity depending on who the audience is" (Interview 11). Similarly, whereas it may be worth putting effort into *fostering excitement* with some audiences, this may not be as relevant when the audience is already interested in the topic. Trainers shared the same observation relative to the *building trust* objective.

Another communication skill that several trainers said they emphasized was the need to send desirable *nonverbal* signals. For example, one trainer said they focused on *nonverbal* skills to avoid having scientists "default to something that puts an invisible barrier between them and the public" (Interview 21). Multiple trainers also highlighted the skill of *storytelling*, noting that they "really encouraged" scientists to tell stories about their own "progression" (Interview 13) and helped scientists develop their stories to

make them more compelling (Interview 15). *Storytelling*, in this regard, was sometimes linked to helping *increasing knowledge* or *fostering excitement* (Interview 5), as well as *framing issues* (Interviews 6 and 13).

Discussion

The science communication trainer interviews conducted for this research suggest that scientists are coming to science communication with their own goals (RQ1) and that trainers are trying to help these scientists achieve these goals. These goals include a relatively limited range of internal goals focused on individual achievement and a related set of external goals focused on benefits to society (RQ2). However, whereas trainers appeared quite comfortable talking about the goals that scientists hoped to achieve through communication, the only specific communication-oriented objectives (RQ3) they regularly raised without prompting focused on *increasing knowledge*. Other potential objectives trainers might have raised, including *building trust* or *framing issues*, were only rarely raised without prompting and did not appear to be an explicit part of training. In contrast to objectives, trainers highlighted a number of specific skills that their training was trying to help scientists develop. These skills were generally only implicitly connected to objectives or goals, if connected at all.

Over the course of the interviews, the research team began thinking about existing science communication training as adopting a journalistic model rather than a strategic model. The problem with this is that journalists are generally not supposed to promote a limited set of specific policy positions (Kovach & Rosenstiel, 2014), whereas scientists who engage with the public appear to frequently have science-focused goals (e.g., the results for RQ2). It is possible to think of many ways in which journalists and scientists share values (i.e., a commitment to truth), but it also seems ingenuous to think that science communicators are not choosing what to communicate based on the degree to which they believe such communication will have a desired impact. It could be argued that scientists are like news columnists, but again, columnists are charged with writing about a variety of issues and not meant to have vested interest in the issues they support. Scientists generally have a direct interest in what they communicate about. Given that science communicators are not science journalists, this suggests that journalism training may not be appropriate. Training focused on strategy that stems, in part, from well-established tenets from public relations research (e.g., Broom & Dozier, 1986; Dozier & Broom, 1995; Grunig & Grunig, 1989; Hon, 1998) might thus be appropriate. Insights from other scientific disciplines should also be considered. Psychology's goal-setting theory (Locke & Latham, 1990, 2002, 2006), for example, may be a

helpful framework through which to further understand the role of objectives and goals within the context of science communication training.

Ultimately, if we are correct that strategic communication training is needed, the implication of the current research is that trainers might benefit from support that helps them provide training that starts with overall, long-term goals but then identifies the intermediate objectives that might allow scientists to achieve these goals. Doing so could help prioritize training focused on the skills that help achieve specific objectives and, thus, potentially, goals. A focus on the range of potential pathways between specific communicative acts, communication objectives, and long-term goals might help scientists, for example, see the strategic value of ensuring that communication does more than simply educate.

Limitations and Future Research

The main limitation of the current study is that it focuses only on North American trainers. Similarly, the fact that we focused on qualitative responses means that it would be unwise to generalize from the results. Nevertheless, there was substantial consistency in trainers' responses that make us confident that the interviews provide a strong understanding of how this community was thinking about training at the time of the interviews. Furthermore, while we only interviewed two people involved in training from groups who are underrepresented in the sciences, all the trainers interviewed said they felt they trained a diverse range of scientists.

Another important limitation of the current study is that because most trainers did not spontaneously talk about communication objectives beyond *increasing knowledge*, the objectives discussed above were those that were raised as part of the interview protocol. These objectives—including *fostering excitement, building trust*, and *framing issues*—were raised because of their prominence in current science communication research. Other objectives could also, however, have been raised, including objectives such as creating a sense of shared identity or values, increasing individuals' sense of internal or external efficacy, or changing perceptions of either descriptive or injunctive norms. Many of these, for example, are objectives sought in campaigns aimed at changing health-related behavior. Going forward, however, researchers will need to grapple with the related normative issue of establishing *what specific objectives and goals* are most appropriate for science communication trainers to prioritize in their curricula. We hope this work will draw attention to and begin disentangling this issue, but it is only a necessary first step.

The current study used interviews to begin to understand how science communication trainers are thinking about their work, but additional research

could use methods such as participant observation and a formal analysis of training curricula or lesson plans to round out the current results. This work could be done in North America as well as more broadly. The relatively small population likely precludes quantitative research aimed at connecting trainers' views and backgrounds with their approach to training, but additional qualitative work might seek to further explore such questions.

For the current research team, the next step will be to build on trainers' understanding of communication skills, communication objectives, and long-term goals sought from public engagement. The task will require trying to build a framework that would help the training community identify and make connections between specific communication choices (e.g., channel, message choice), objectives that might be consistent with these choices (e.g., existing audiences, conveying shared values), and the ultimate goals that scientists have when they communicate (e.g., boosting STEM [science, technology, engineering, and mathematics] recruitment, influencing policy). Our research team is also seeking to better understand what scientists think about objectives and goals based on a concern that they may be uncomfortable or unfamiliar with pursuing certain objectives as a path to their goals. In such cases, it will be important to understand these concerns and either seek to alleviate them or help such scientists find alternative paths to their goals. A discussion of the ethics of specific objectives and goals is part of this work.

Authors' Note

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