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Attending to adversarial science communication: a commentary on Lewenstein and Baram-Tsabari's vision of science communication education

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ABSTRACT

Unlike K-12 science teachers who can turn to national documents such as the *Next Generation Science Standards* for guidance on what knowledge and skills are central to their disciplines, university educators who set out to teach science communication are faced with the challenge of having to develop/implement a curriculum without the benefit of a well-established disciplinary core. In the present commentary, we discuss how the framework proposed by Lewenstein and Baram-Tsabari's (2022) begins to address this issue by taking a first step toward the articulation of a blueprint of science communication education. The commentary is organized as follows. First, Lewenstein and Baram-Tsabari's (2022) article is considered in light of prior work by other science communication scholars. Attention then shifts to what our own research has revealed as an important absence in Lewenstein and Baram-Tsabari's (2022) framework, namely the lack of attention given to training in adversarial science communication (e.g. addressing pseudoscience online, public debates). We then end by suggesting ways to attend to this issue, while emphasizing the need for continued field-wide (re)formulation of a common educational vision in/for the teaching and learning of science communication.

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There is growing recognition among university science educators of the critical need to prepare future scientists to effectively communicate with the public (Barwick et al., 2014; Besley & Dudo, 2017; Goldina & Weeks, 2014). Yet, it is not uncommon for the subject of public science communication to receive limited attention or to be completely absent from the undergraduate science curriculum (Bankston & McDowell, 2018; Besley & Tanner, 2011; Brownell et al., 2013). This apparent incongruence has been attributed at least in part to the nonexistence of a universal framework or blueprint for successful teaching in science communication (Bankston & McDowell, 2018; Mulder et al., 2008). Unlike K-12 science teachers who can turn to national documents such as the *Next Generation Science Standards* for guidance on what knowledge and skills are central to their disciplines, university educators who set out to teach science communication are faced with the challenge of having to develop/implement a curriculum without the benefit of a well-established disciplinary core (i.e. an agreed-upon body of content and set of competencies) or a shared educational vision.

A welcomed and timely contribution to address this situation, Lewenstein and Baram-Tsabari's (2022) article is considered in the present commentary in light of prior work by other science

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communication scholars (Chan, 2011; Mercer-Mapstone & Kuchel, 2017), including our own (Chiu et al., in press; Oliveira et al., 2023). Our commentary is organized as follows: First, we discuss how Lewenstein and Baram-Tsabari's (2022) new educational vision compares to older ones available in the field. Attention then shifts to what our own research has revealed as an important absence in Lewenstein and Baram-Tsabari's (2022) framework, namely the lack of attention given to training in adversarial science communication (e.g. addressing pseudoscience online, public debates). We then end by suggesting ways to attend to this issue, while emphasizing the need for continued field-wide (re)formulation of a common educational vision in/for the teaching and learning of science communication.

Toward a blueprint of science communication education

In their proposal on how to structure science communication training, Lewenstein and Baram-Tsabari (2022) theorize that the science communication community comprises different types of members whose practices are situated at various positionalities ranging from *occasional science communicators* (located at the 'periphery') to *active science communicators* (individuals who embrace science communication as a key part of their professional activities but have other primary commitments, such as a scientist who maintains a blog for the general public) to *professional science communicators* (located at the 'core'). Therefore, it is posited that science communication training for each type of member should be structured differently, tailored to their unique professional needs according to the communicative activities they perform. The closer to the community core, the more content knowledge and communicative skills one needs. In addition, Lewenstein and Baram-Tsabari (2022) recommend that trainees should be engaged in authentic communicative tasks, such as the production of media content (e.g. op-ed, blog, podcast, video), interactions with journalists (e.g. being interviewed), social media (e.g. tweet about science, post on Instagram, create a TikTok), museums (e.g. design and build an exhibit), talks (e.g. science café, school talk), dialogic events (e.g. consensus forum, public meeting, consultation), and public participation in scientific research (e.g. design a citizen science project).

Prior to the publication of Lewenstein and Baram-Tsabari (2022), the only available blueprints for science communication education were short lists of communicative skills found in isolated publications. A good example is Chan (2011), who advocated for the embedding of oral communication training (e.g. PowerPoint and poster presentations) into undergraduate science courses. As a result, undergraduate students were expected to develop eight basic skills, including catering to audiences, handling conflict, constructively critiquing work by others, and responding to questions. The lack of mention of any form of specialized knowledge (e.g. theories of communication) suggests that science communication ability/expertise was approached superficially as mere familiarity with a set of 'tricks of trade' for giving effective presentations to specialized audiences.

A more developed – or perhaps complementary – educational proposal can be found in Mercer-Mapstone and Kuchel (2017), who set out to develop an academic resource 'to guide the teaching of communication with non-scientific audiences for an undergraduate science context' (p. 1). For them, effective science communication is envisioned as a more complex type of expertise whose development requires reflective practice based on specialized knowledge and attention to nuance/context. Based on an extensive literature review and expert survey, the authors assembled a list of *12 core skills for effective science communication* that included the ability to identify and understand a target audience, promotion of audience engagement, awareness of the sociopolitical and cultural contexts, storytelling ability, and knowledge of science communication theories. A comparison between strategies skills and strategies of effective science communication between Chan (2011) and Mercer-Mapstone and Kuchel (2017) is offered in Table 1.

Lewenstein and Baram-Tsabari (2022) articulate a more sophisticated vision of science communication education than the two previous works in that it is theory-based, multi-dimensional (not a list), nuanced, and consistent with developmental perspectives on expertise growth (Mieg,

Table 1. Comparison between strategies skills and strategies of effective science communication as proposed by Chan (2011) and Mercer-Mapstone and Kuchel (2017).

Chan's (2011) Oral Communication Skills for Effective Science Communication	Mercer-Mapstone and Kuchel's (2017) 12 Core skills for effective science communication
- How to plan, prepare and develop a good poster/ PowerPoint presentation. - What makes a good/bad presentation. - How to understand and cater to the different interests and learning styles in an audience. - How to effectively work in groups and handle conflict. - How to develop questions and to constructively critique work by others. - How to respond to questions. - - Identification of ineffective presentation techniques, such as bad body language, eye contact, tone and pace.	- Identify and understand target audience. - Use language that is appropriate for your target audience. - Identify the purpose and intended outcome of the communication (take-home message). - Consider the level of prior knowledge in the target audience. - Separate essential from non-essential factual content in a context that is relevant to the target audience. - Use a suitable mode and platform to communication with the target audience. - Consider the social, political and cultural context of the scientific information. - Use/consider style elements appropriate for the mode of communication (humor, anecdotes, analogy, body language, etc.). - Understand the underlying theories leading to the development of science communication and why they are important. - Promote audience engagement with the science. - Use the tools of storytelling and narrative. - Encourage a two-way dialogue with the audience.

2006; 2009). In other words, rather than being provided with what comes across as a 'failproof recipe for the effective communication of science', science communication students are presented with a flexible roadmap that can be adapted to different communicative situations, target populations, and learning objectives. Despite constituting a major step forward in the articulation of a common educational target for the field, Lewenstein and Baram-Tsabari's (2022) vision overlooks adversarial forms of science communication, such as responding to pseudoscience online or engaging in public debates. As elaborated in the following section, we believe this to be an important aspect of the scholarship of science communication that higher education needs to address in their efforts to prepare the next generation of science communicators.

Adversarial science communication

As part of a research study (Chiu et al., in press), we recently set out to examine the impact of an educational program in which a group of undergraduate science students received training and then practiced debating science topics politicized in social media. The program was aimed at preparing science undergraduates for participation in emotionally demanding communicative events that are adversarial/ combative in nature (i.e. that involve heated disagreement).

While working on that research study, we came across Lewenstein and Baram-Tsabari's seminal work and noticed the lack of references to public debates or the recognition of the importance of pedagogically promoting student development of communicative competence in adversarial social contexts. Although the authors acknowledge that science communication learning involves affective aspects, their education vision seems limited to general motivations and attitudes (e.g. science professionals should learn to 'feel comfortable interacting with the media,' 'develop sensitivity towards audience views and concerns' and 'approach communication with openness, honesty, and responsibility').

It is well documented in the literature that public engagement with (socio)scientific issues has become increasingly combative as many societies around the world grow more polarized (e.g. Kidd, 2020; Hundleby, 2013; Rooney, 2012). The result is the common occurrence of heated (i.e. emotional, angry) disputes as individuals confrontationally resist persuasion (Compton et al., 2021). For that reason, there currently exists a pressing need to prepare future scientists to effectively communicate in societal contexts fraught with controversy and divergence (Rekker, 2021).

Unfortunately, the omission of public debating of science in the field of science communication is symptomatic of the limited attention generally given to scientists' need for training in adversarial communication (Rancer & Avtgis, 2006). Thus, it becomes possible that future scientists may be left unprepared to face increasingly common situations involving combativeness and confrontation (Brownell et al., 2013; Ceccarelli, 2011) that are typical of the current sociopolitical trends of polarization (Hundleby, 2013; Nisbet & Fahy, 2015). Contrary to what seems to be the naïve expectation underlying much of the science communication training opportunities currently available to undergraduate students, future science professionals will not always be faced with audiences who are friendly or passive enough to accept their communicative efforts without any contention. Next, we consider ways that educational practitioners can address this issue.

Attending to adversarial science communication

Being able to effectively handle science communication exchanges characterized by adversarial interactions is far from easy and straightforward. It is a multifaceted task that requires a diversity of skills to be undertaken masterfully as we suggest elsewhere (Chiu et all, *in press*; Oliveira et al., 2023). Some features of the adversarial confrontations that may challenge science students include dealing with stress and emotional management; having an understanding of one's own personal biases and those of others, how to address them, and how to use them to one's advantage; and

Table 2. Sequence of classroom activities used to prepare students for adversarial science communication.

Activity	Description
Personalize your research (oral presentation)	Early in the term, students participated in an ice-breaking and get-to-know-you activity in which each had two minutes at a *mock cocktail party* to talk about their science research interests in a way that was (1) appropriate for such an informal social setting and (2) engaging for an audience not specialized in the science being communicated. This allowed students to practice being empathetic to their audience's interests and values, using rhetorical techniques such as telling a story, and managing personal stress.
Responding to pseudoscience (written assignment)	Following a lecture on how to recognize and respond to online pseudoscience, students were tasked with (1) finding an example of pseudoscience on the Internet, (2) analyzing the communicative techniques used by its proponents, and (3) describing how they would persuade a hypothetical audience to reject it. Students practiced incorporating empathy for their audience while also attempting to portray themselves as individuals who can be trusted.
Theatrical improvisation activities for working on body language	Throughout the term, students engaged in several activities meant to showcase the use of body language in conveying confidence, positionality, personality, emotionality and other elements that may be communicated visually and physically. These activities allowed students to practice managing felt stress and anxiety felt when talking in public and preventing their body language from adversely affecting their performance.
Media interviews (oral presentation)	Following a lecture on the strategies for successful media interviews, students were interviewed by a real journalist asking them about their scientific research. The students were tasked with preparing their main talking points and stories that would humanize their science to make it accessible and engaging to non-scientific audiences. During these 'live' interviews, the journalist could pivot quickly from friendly and encouraging questions to more challenging and antagonistic ones, so students needed to be prepared to remain calm through practiced emotional management and to steer the conversational focus back to the talking points that could tell the story they wanted to be heard.
Debates (oral presentation)	At the end of term, in a capstone learning activity, students debated either 'for' or 'against' statements on scientific controversy. 'Winning' these debates required demonstration of deft mastery of all the adversarial communication skills touched upon in the previous activities.

recognizing and harnessing the power of empathy and appearing relatable and engaging to audience members. Lastly, it is important to deftly employ rhetorical strategies, like storytelling, personalizing the issue at hand, and framing contexts in ways that align with the values of audience members. Doing so can help maintain constructive discussions (rather than escalate conflicts) and foster trustworthiness as a positional stance, hence increasing the chances that the arguments made will resonate with (and be listened by) disagreeing parties.

Given the large diversity of skills needed to master adversarial communication, their teaching and learning require a more extended intervention in the form of a series of activities that build upon each other cumulatively over time. Furthermore, these types of skills must be put into practice, which makes experiential learning an essential component of adversarial communication training. That is, students must be exposed to scenarios that allow them to practice dealing with confrontation and to experience the feelings associated with them.

This was precisely our approach when designing and implementing an undergraduate course called *The Public of Communication of Science* at the University of Ottawa (Canada). To prepare our students, we utilized a series of classroom activities (Table 2) that culminated with an adversarial debate (the cumulative semester-end class assignment). Throughout these course activities, the threshold concepts of *audience-centered communication*, *the deficit model*, and trust were critically studied and performed (practiced) via lectures, class discussions, and graded feedback.

Although such carefully designed interventions were generally successful, future work is needed to continue to investigate the effectiveness of such an approach to adversarial science communication training in relation to specific characteristics of students (i.e. first language, previous science background, etc.).

Conclusion

It has long been emphasized in K-12 education that having a shared vision for a subject is important for the success of any educational effort. A vision can help guide the coordination of efforts toward common goals, particularly if it is a result of a continued process of social construction wherein members of a community come to a high degree of agreement about what they want to achieve and how they want to do it (Vandenberghe & Staessens, 1994). Vision and vision-building play a central role in the creation of educational standards, a critical step in the road to formalization of an area of expertise (Alexander, 2003). This is precisely why we consider Lewenstein and Baram-Tsabari's (2022) proposed structuring of science communication to be an essential development in our field. It is in this spirit of advancing the field that our comments about the lack of attention to adversarial science communication should be taken. Rather than empty criticism, our hope is that our comments can help open dialogue as a clearer and more developed vision for science communication education begins to emerge in our field.

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